Accepted SB Nov/09/2011

FAA FORM 8130-6, APPLICATION FOR U.S. AIRWORTHINESS CERTIFICATE

Form Approved O.M.B. No. 2120-0018
12/31/2010

U.S. Department of Transportation
Federal Aviation Administration

APPLICATION FOR U.S. AIRWORTHINESS CERTIFICATE

INSTRUCTIONS - Print or type. Do not write in shaded areas; these are for FAA use only. Submit original only to an authorized FAA Representative. If additional space is required, use attachment. For special flight permits complete Sections II, VI and VII as applicable.

I. AIRCRAFT DESIGNATION

1. REGISTRATION MARK N441KS	2. AIRCRAFT BUILDER'S NAME *(Make)* Sands Concepts	3. AIRCRAFT MODEL DESIGNATION Sandstorm	4. YR. MFR. 2010	FAA CODING
5. AIRCRAFT SERIAL NO. 11-001E	6. ENGINE BUILDER'S NAME *(Make)* Hacker	7. ENGINE MODEL DESIGNATION A60-18L		
8. NUMBER OF ENGINES 1	9. PROPELLER BUILDER'S NAME *(Make)* Mejzlik	10. PROPELLER MODEL DESIGNATION Modellbau 21X12	11. AIRCRAFT IS *(Check if applicable)* ☐ IMPORT	

II. CERTIFICATION REQUESTED

APPLICATION IS HEREBY MADE FOR: *(Check applicable items)*

- A 1 ☐ STANDARD AIRWORTHINESS CERTIFICATE *(Indicate Category)* ☐ NORMAL ☐ UTILITY ☐ ACROBATIC ☐ TRANSPORT ☐ COMMUTER ☐ BALLOON ☐ OTHER
- B ✔ SPECIAL AIRWORTHINESS CERTIFICATE *(Check appropriate items)* UNMANNED AIRCRAFT
  - 7 ☐ PRIMARY
  - 9 ☐ LIGHT-SPORT *(Indicate Class)* ☐ AIRPLANE ☐ POWER-PARACHUTE ☐ WEIGHT-SHIFT-CONTROL ☐ GLIDER ☐ LIGHTER THAN AIR
  - 2 ☐ LIMITED
  - 5 ☐ PROVISIONAL *(Indicate Class)*: 1 ☐ CLASS I; 2 ☐ CLASS II
  - 3 ☐ RESTRICTED *(Indicate operation(s) to be conducted)*: 1 ☐ AGRICULTURE AND PEST CONTROL; 2 ☐ AERIAL SURVEY; 3 ☐ AERIAL ADVERTISING; 4 ☐ FOREST *(Wildlife Conservation)*; 5 ☐ PATROLLING; 6 ☐ WEATHER CONTROL; 0 ☐ OTHER *(Specify)*
  - 4 ✔ EXPERIMENTAL *(Indicate operation(s) to be conducted)*: 1 ✔ RESEARCH AND DEVELOPMENT; 2 ☐ AMATEUR BUILT; 3 ☐ EXHIBITION; 4 ☐ AIR RACING; 5 ☐ CREW TRAINING; 6 ✔ MARKET SURVEY; 0 ☐ TO SHOW COMPLIANCE WITH THE CFR; 7 ☐ OPERATING *(Primary Category)* KIT BUILT AIRCRAFT; 8 OPERATING LIGHT-SPORT: 8A ☐ Existing Aircraft without an airworthiness certificate & do not meet § 103.1; 8B ☐ Operating Light-Sport Kit-Built; 8C ☐ Operating light-sport previously issued special light-sport category airworthiness certificate under § 21.190
  - 8 ☐ SPECIAL FLIGHT PERMIT *(Indicate operation(s) to be conducted, then complete Section VI or VII as applicable on reverse side)*: 1 ☐ FERRY FLIGHT FOR REPAIRS, ALTERATIONS, MAINTENANCE, OR STORAGE; 2 ☐ EVACUATION FROM AREA OF IMPENDING DANGER; 3 ☐ OPERATION IN EXCESS OF MAXIMUM CERTIFICATED TAKE-OFF WEIGHT; 4 ☐ DELIVERING OR EXPORTING; 5 ☐ PRODUCTION FLIGHT TESTING; 6 ☐ CUSTOMER DEMONSTRATION FLIGHTS
- C 6 ☐ MULTIPLE AIRWORTHINESS CERTIFICATE *(check ABOVE "Restricted Operation" and "Standard" or "Limited" as applicable)*

III. OWNER'S CERTIFICATION

A. REGISTERED OWNER *(As shown on certificate of aircraft registration)* — IF DEALER, CHECK HERE → ☐

NAME Unmanned Systems, Inc.	ADDRESS 2709 Cyrano Street Henderson NV 89044

B. AIRCRAFT CERTIFICATION BASIS *(Check applicable blocks and complete items as indicated)*

☐ AIRCRAFT SPECIFICATION OR TYPE CERTIFICATE DATA SHEET *(Give No. and Revision No.)* N/A	✔ AIRWORTHINESS DIRECTIVES *(Check if all applicable AD's are complied with and give the number of the last AD SUPPLEMENT available in the biweekly series as of the date of application)* Bi-weekly 2011-19
☐ AIRCRAFT LISTING *(Give page number(s))* N/A	☐ SUPPLEMENTAL TYPE CERTIFICATE *(List number of each STC incorporated)* N/A

C. AIRCRAFT OPERATION AND MAINTENANCE RECORDS

✔ CHECK IF RECORDS IN COMPLIANCE WITH 14 CFR Section 91.417	TOTAL AIRFRAME HOURS 78.5	3 EXPERIMENTAL ONLY *(Enter hours flown since last certificate issued or renewed)* 0.0

D. CERTIFICATION - I hereby certify that I am the registered owner (or his agent) of the aircraft described above, that the aircraft is registered with the Federal Aviation Administration in accordance with Title 49 of the United States Code 44101 et seq. and applicable Federal Aviation Regulations, and that the aircraft has been inspected and is airworthy and eligible for the airworthiness certificate requested.

DATE OF APPLICATION	NAME AND TITLE *(Print or type)*	SIGNATURE
09/13/2011	Donald G. Bintz, CEO	[signature]

IV. INSPECTION AGENCY VERIFICATION

A. THE AIRCRAFT DESCRIBED ABOVE HAS BEEN INSPECTED AND FOUND AIRWORTHY BY: *(Complete this section only if 14 CFR part 21.183(d) applies.*

2 ☐ 14 CFR part 121 CERTIFICATE HOLDER *(Give Certificate No.)*	3 ☐ CERTIFICATED MECHANIC *(Give Certificate No.)*	6 ☐ CERTIFICATED REPAIR STATION *(Give Certificate No.)*
5 ☐ AIRCRAFT MANUFACTURER *(Give name or firm)*		
DATE	TITLE	SIGNATURE

V. FAA REPRESENTATIVE CERTIFICATION

(Check ALL applicable block items A and B)

A. I find that the aircraft described in Section I or VII meets requirements for ✔ THE CERTIFICATE REQUESTED; 4 ☐ AMENDMENT OR MODIFICATION OF CURRENT AIRWORTHINESS CERTIFICATE

B. Inspection for a special permit under Section VII was conducted by: ✔ FAA INSPECTOR; ☐ FAA DESIGNEE; ☐ CERTIFICATE HOLDER UNDER ☐ 14 CFR part 65 ☐ 14 CFR part 121 OR 135 ☐ 14 CFR part 145

DATE	MIDO/FSDO Office	DESIGNEE'S SIGNATURE AND NO.	FAA INSPECTOR'S SIGNATURE
09/14/2011	NM-51	4	1 Michael Millage [signature]

VI. PRODUCTION FLIGHT TESTING

A. MANUFACTURER

NAME	ADDRESS

B. PRODUCTION BASIS *(Check applicable item)*

- [ ] PRODUCTION CERTIFICATE *(Give production certificate number)* →
- [ ] TYPE CERTIFICATE ONLY
- [ ] APPROVED PRODUCTION INSPECTION SYSTEM

C. GIVE QUANTITY OF CERTIFICATES REQUIRED FOR OPERATING NEEDS

DATE OF APPLICATION	NAME AND TITLE *(Print or Type)*	SIGNATURE

VII. SPECIAL FLIGHT PERMIT PURPOSES OTHER THAN PRODUCTION FLIGHT TEST

A. DESCRIPTION OF AIRCRAFT

REGISTERED OWNER	ADDRESS
BUILDER *(Make)*	MODEL
SERIAL NUMBER	REGISTRATION MARK

B. DESCRIPTION OF FLIGHT — CUSTOMER DEMONSTRATION FLIGHTS ☐ *(Check if applicable)*

FROM	TO	
VIA	DEPARTURE DATE	DURATION

C. CREW REQUIRED TO OPERATE THE AIRCRAFT AND ITS EQUIPMENT

- [ ] PILOT
- [ ] CO-PILOT
- [ ] FLIGHT ENGINEER
- [ ] OTHER *(Specify)*

D. THE AIRCRAFT DOES NOT MEET THE APPLICABLE AIRWORTHINESS REQUIREMENTS AS FOLLOWS:

E. THE FOLLOWING RESTRICTIONS ARE CONSIDERED NECESSARY FOR SAFE OPERATION: *(Use attachment if necessary)*

F. CERTIFICATION – I hereby certify that I am the registered owner (or his agent) of the aircraft described above; that the aircraft is registered with the Federal Aviation Administration in accordance with Title 49 of the United States Code 44101 et seq. and applicable Federal Aviation Regulations; and that the aircraft has been inspected and is safe for the flight described.

DATE	NAME AND TITLE *(Print or Type)*	SIGNATURE

VIII. AIRWORTHINESS DOCUMENTATION (FAA/DESIGNEE use only)

✓	A. Operating Limitations and Markings in Compliance with 14 CFR Section 91.9, as applicable.		G. Statement of Conformity, FAA Form 8130-9 *(Attach when required)*
✓	B. Current Operating Limitations Attached		H. Foreign Airworthiness Certification for Import Aircraft *(Attach when required)*
✓	C. Data, Drawings, Photographs, etc. *(Attach when required)*		I. Previous Airworthiness Certificate Issued in Accordance with 14 CFR Section ______ CAR ______ *(Original Attached)*
✓	D. Current Weight and Balance information Available ~~in Aircraft~~ at Local Pilot Controller		
	E. Major Repair and Alteration, FAA Form 337 *(Attach when required)*	✓	J. Current Airworthiness Certificate Issued in Accordance with 14 CFR Section 21.191(a)(f) *(Copy Attached)*
✓	F. This inspection Recorded in Aircraft Records		K. Light-Sport Aircraft Statement of Compliance, FAA Form 8130-15 *(Attach when required)*

COPY

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION - FEDERAL AVIATION ADMINISTRATION

SPECIAL AIRWORTHINESS CERTIFICATE

A	CATEGORY/DESIGNATION	Experimental (UNMANNED AIRCRAFT)	
	PURPOSE	Research & Development/Market Survey	
B	MANU-FACTURER	NAME	N/A
		ADDRESS	N/A
C	FLIGHT	FROM	N/A
		TO	N/A
D	N- 441KS		SERIAL NO. 11-001E
	BUILDER Sands Concepts		MODEL Sandstorm
E	DATE OF ISSUANCE 9/14/2011		EXPIRY 9/13/2012
	OPERATING LIMITATIONS DATED 9/14/2011 ARE PART OF THIS CERTIFICATE		
	SIGNATURE OF FAA REPRESENTATIVE Michael Millage (signature) Michael Millage FAA ASI		DESIGNATION OR OFFICE NO. Seattle MIDO - NM-51

Any alteration, reproduction or misuse of this certificate may be punishable by a fine not exceeding $1,000 or imprisonment not exceeding 3 years, or both. THIS CERTIFICATE MUST BE DISPLAYED IN THE AIRCRAFT IN ACCORDANCE WITH APPLICABLE TITLE 14, CODE OF FEDERAL REGULATIONS (CFR).

A	This airworthiness certificate is issued under the authority of Public Law 104-6, 49 United States Code (USC) 44704 and Title 14 Code of Federal Regulations (CFR).
B	The airworthiness certificate authorizes the manufacturer named on the reverse side to conduct production flight tests, and only production flight tests, of aircraft registered in his name. No person may conduct production flight tests under this certificate: (1) Carrying persons or property for compensation or hire: and/or (2) Carrying persons not essential to the purpose of the flight.
C	This airworthiness certificate authorizes the flight specified on the reverse side for the purpose shown in Block A.
D	This airworthiness certificate certifies that as of the date of issuance, the aircraft to which issued has been inspected and found to meet the requirements of the applicable CFR. The aircraft does not meet the requirements of the applicable comprehensive and detailed airworthiness code as provided by Annex 8 to the Convention On International Civil Aviation. No person may operate the aircraft described on the reverse side: (1) except in accordance with the applicable CFR and in accordance with conditions and limitations which may be prescribed by the Administrator as part of this certificate; (2) over any foreign country without the special permission of that country.
E	Unless sooner surrendered, suspended, or revoked, this airworthiness certificate is effective for the duration and under the conditions prescribed in 14 CFR, Part 21, Section 21.181 or 21.217.

09/14/2011

Transport Airplane Directorate
Aircraft Certification Service
Seattle MIDO
1601 Lind Avenue S.W.
Renton, WA 98057

Operating Limitations
Experimental: Research and Development, Market Survey

Registered Owner Name: Unmanned Systems, Inc.	**Aircraft Builder:** Sands Concepts
Registered Owner Address: 2709 Cyrano St. Henderson, NV 89044	**Aircraft Serial Number:** 11-001E
Aircraft Description: Sandstorm Unmanned Aircraft Fixed Wing, Electric Prop	**Aircraft Model Designation:** Sandstorm
Aircraft Registration: N441KS	**Engine Model:** Hacker A60-18L
Year Manufactured: 2010	**Propeller Model:** Mejzlik Modellbau 21 x 12

The following conditions and limitations apply to all flight operations for the Unmanned Systems, Inc., (USI) Sandstorm unmanned aircraft system (UAS) while operating in the National Airspace System (NAS).

1. General Information.

a. Integrated System. For the purposes of this special airworthiness certificate and operating limitations, the Sandstorm UAS operated by USI is considered to be an integrated system. The system is composed of the following:

(1) Sandstorm unmanned aircraft, serial number 11-001E.

(2) UAS control station(s) that are fixed or mobile, and ground-based.

(3) Telemetry, launch, and recovery equipment.

(4) Communications and navigation equipment, including ground and/or air equipment used for command and control of the Sandstorm UAS.

(5) Equipment on the ground used for communication with other members of the flightcrew, observers, air traffic control (ATC), and other users of the NAS.

b. Compliance with 14 CFR Part 61 (Certification: Pilots, Flight Instructors, and Ground Instructors) and Part 91 (General Operating and Flight Rules). Unless otherwise specified in this document, the Sandstorm pilot-in-command (PIC) and USI must comply with all applicable sections and parts of 14 CFR including, but not limited to, parts 61 and 91.

c. Operational Requirements.

(1) No person may operate this UAS for other than the purpose of research and development and market survey to accomplish the flight operation outlined in USI's Sandstorm program letter dated 09/13/2011, which describes compliance with § 21.193(d), Experimental certificates: General, and has been made available to the UA PIC.

(2) This UAS must be operated in accordance with applicable air traffic and general operating rules of part 91 and all additional limitations herein prescribed under the provisions of § 91.319(i), Aircraft having experimental certificates: Operating limitations.

(3) The Sandstorm must accumulate at least 50 flight hours before market survey flights are permitted, in accordance with § 21.195(d), Experimental certificates: Aircraft to be used for research and development and market survey. Any flight hours accumulated while the aircraft was previously flown as a "model" may be used toward achieving the 50 flight hour requirement as long as the flight hours were documented in the maintenance records.

d. UA Condition. The UA PIC must determine that the UA is in a condition for safe operation, and in a configuration appropriate for the purpose of the intended flight.

e. Multiple-Purpose Operations. When changing between operating purposes of a multiple purpose certificate, the operator must determine that the aircraft is in a condition for safe operation and appropriate for the purpose intended. A record entry will be made by an appropriately rated person (that is, an individual authorized by the applicant and acceptable to the FAA) to document that finding in the maintenance records.

f. Operation Exceptions. No person may operate this UA to carry property for compensation or hire (§ 91.319(a)(2)).

g. UA Markings.

(1) This UA must be marked with its U.S. registration number in accordance with part 45 or alternative marking approval issued by the FAA Production and Airworthiness Division, AIR-200.

(2) This UA must display the word *Experimental* in accordance with § 45.23(b), Display of marks, unless otherwise granted an exemption from this requirement.

(3) This UA must be marked with a fireproof identification plate that includes the following information: builder's name, model designation, and builder's serial number.

h. Required Documentation. Immediately after the certificate is issued, USI must forward an electronic copy of the Sandstorm program letter, special airworthiness certificate, and operating limitations to the following persons by e-mail:

1) Byron Chew, Unmanned Aircraft Systems Specialist, Western Service Center, Operations Support Group, AJV-W23, byron.ctr.chew@faa.gov, (425) 203-4505 (fax).

2) Tom Rampulla, Production and Airworthiness Division, AIR-200, 800 Independence Ave, SW, Washington, DC 20591, (202) 385-6684, email: thomas.rampulla@faa.gov.

i. Change in Registrant Address. Section 47.45, Change of address, requires that the FAA Aircraft Registry be notified within 30 days of any change in the aircraft registrant's address. Such notification is to be made by providing AC Form 8050-1, Aircraft Registration Application, to the FAA Aircraft Registration Branch (AFS-750) in Oklahoma City, Oklahoma.

j. Certificate Display and Manual Availability. The airworthiness and registration certificates must be displayed, and the aircraft flight manual must be available to the pilot, as prescribed by the applicable sections of 14 CFR, or as prescribed by an exemption granted to USI in accordance with 14 CFR part 11, General Rulemaking Procedures.

2. Program Letter. The Sandstorm program letter, dated 09/13/2011, will be used as a basis for determining the operating limitations prescribed in this document. All flight operations must be conducted in accordance with the provisions of this document.

3. Initial Flight Testing.

a. Requirements. Flight operations must be conducted within visual line of sight of the pilot/observer. Initial flight testing will be complete when the operations manager or chief pilot can certify that the aircraft complies with § 91.319(b). Compliance with § 91.319(b) must be recorded in the aircraft records with the following, or a similarly worded, statement:

> **I certify that the aircraft is controllable throughout its normal range of speeds and throughout all maneuvers to be executed, has no hazardous operating characteristics or design features, and is safe for operation.**

b. Aircraft Operations for the Purpose of Market Surveys. These operations cannot be performed until 50 flight hours have been accomplished. An entry in the maintenance records is required as evidence of compliance.

4. Authorized Flight Operations Area.

a. Description of the Columbia Falls, MT Flight Test Area.

1. The primary flight test area is located near Columbia Falls, Montana. The airspace is centered at 48° 15' 56.45" N and 114° 10' 12.00" W and has a radius of 2000 feet and an altitude of 700 feet above ground level (AGL). The primary flight test area is depicted in Figure 1 and Figure 2.

2. The primary flight test area includes Sands Airstrip and is located approximately 4.5 nm southeast of Glacier Park International airport (KGPI) and 7.4 nm northeast of Kalispell City Airport (S27). The flight test area includes Class D, E, and G airspace. The western section of the flight test area lies within KGPI's Class D surface area. This airspace reverts to Class E when KGPI's tower is closed. The eastern section of the flight test area is Class G airspace for operations below 700 feet AGL. Class E airspace begins at 700 feet and above in the eastern section. The Class D airspace is under the jurisdiction of KGPI's tower during operating hours. Otherwise, when the

KGPI tower is closed, the Class E airspace is under the jurisdiction of Salt Lake Air Route Air Traffic Control Center (ARTCC).

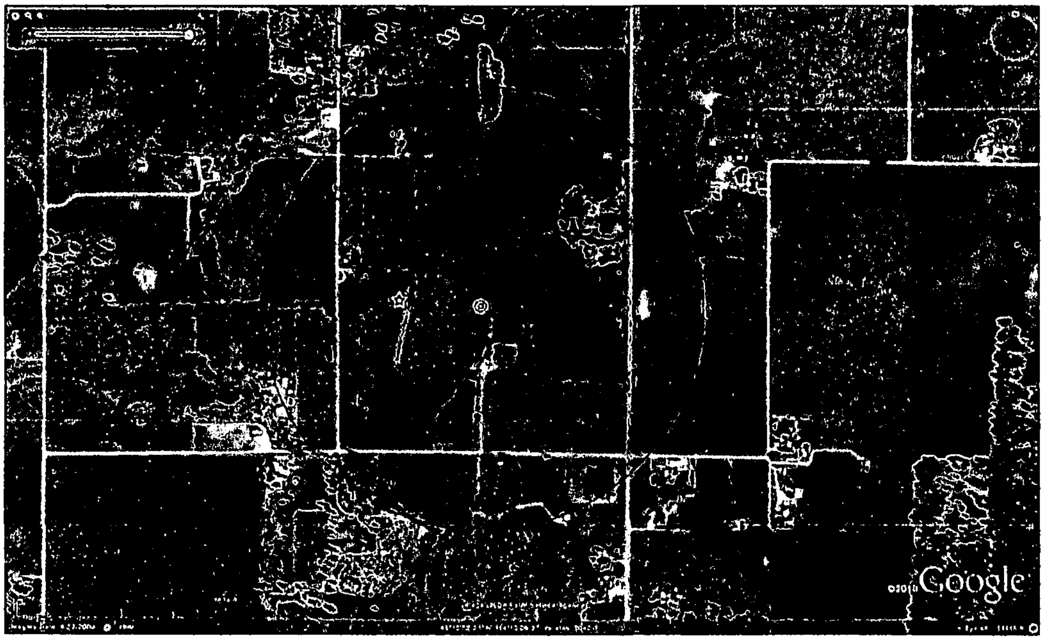


Figure 1. Primary flight test area in Columbia Falls, MT.

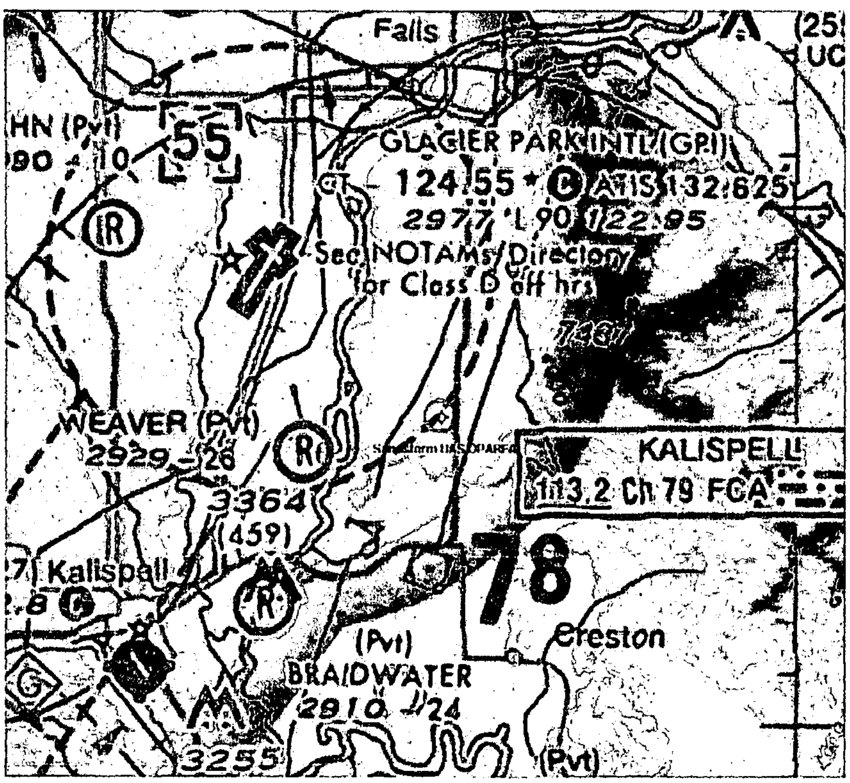


Figure 2. Sectional Chart of primary flight test area in Columbia Falls, MT.

b. Description of the Malmstrom AFB Flight Test Area.

1. A secondary flight test area is located at Malmstrom AFB, Montana. The airspace is 7,419 feet long and 3000 feet wide up to an altitude of 700 feet AGL. This flight test area is depicted in Figure 3 and Figure 4.

Northwest corner	**47° 30' 38.33" N 111° 11' 1.70" W**
Northeast corner	**47° 30' 18.38" N 111° 10' 29.40" W**
Southeast corner	**47° 29' 24.16" N 111° 11' 27" W**
Southwest corner	**47° 29' 44" N 111° 12' 15" W**

2. The Malmstrom flight test area includes airspace over the southern part of the closed runway. The Sandstorm may operate from this closed runway or the parking ramp as long as the takeoff and landing surface lies within the coordinates above. Furthermore, the Sandstorm must also remain within 2000 feet from the point where it initiated its takeoff roll. The Great Falls International Airport (KGTF) is located approximately 7 nm west of the flight test area. The Malmstrom flight test area includes Class E and G airspace.

3. This flight test area is only authorized for a one-time use market survey event hosted by Montana State Senator Ryan Zinke.

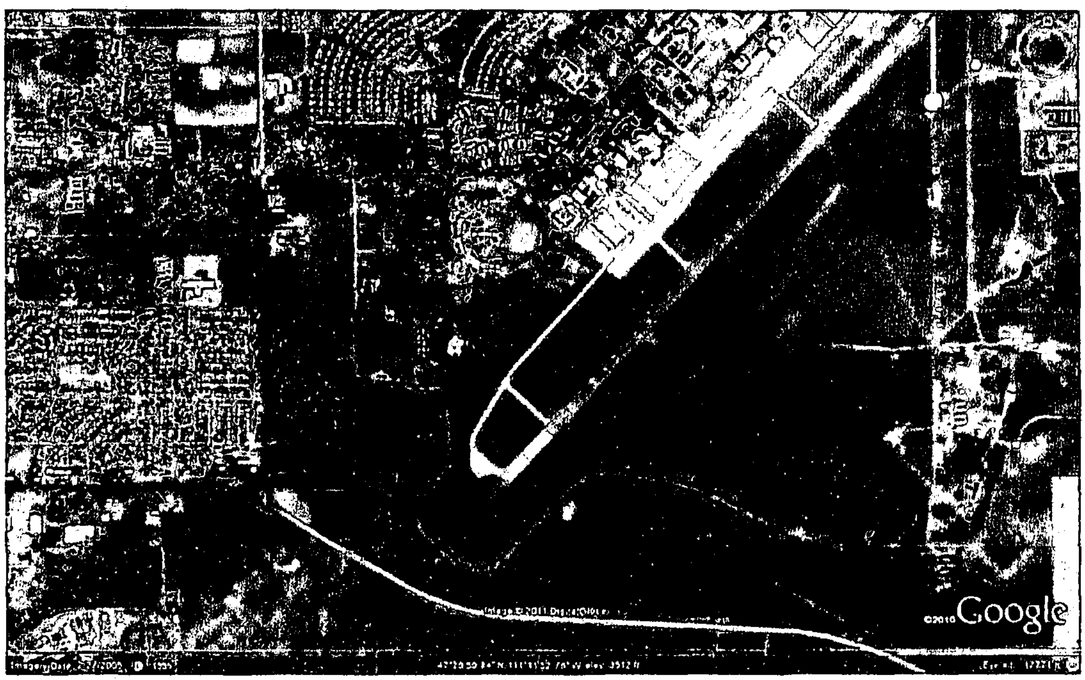


Figure 3. Malmstrom AFB flight test area.

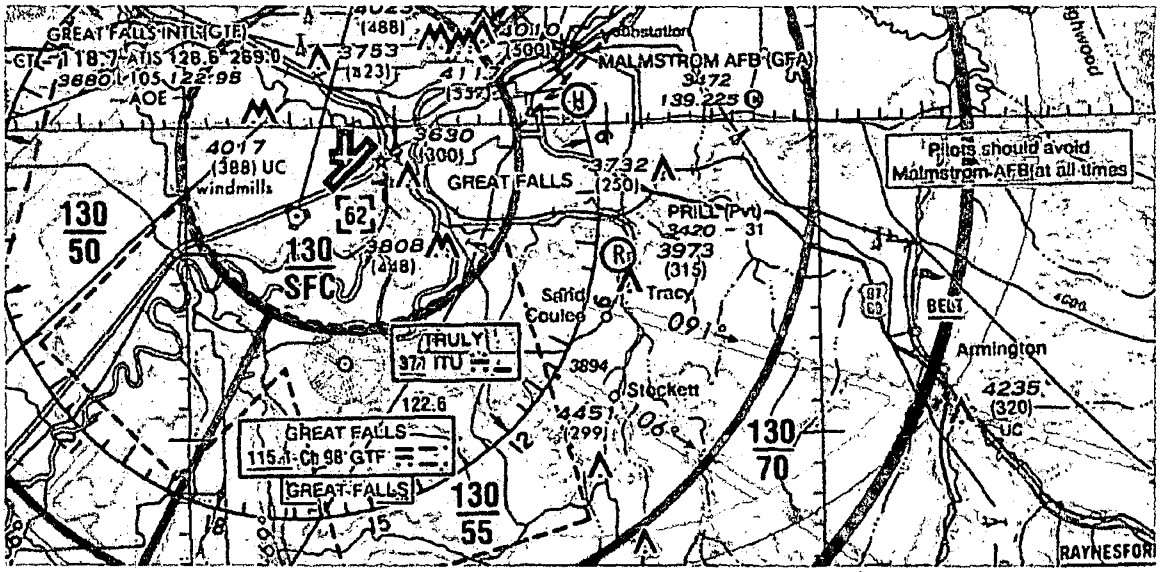


Figure 4. Sectional Chart of Malmstrom AFB flight test area.

c. Authorized Flight Times and Conditions. All flight operations must be conducted during daylight hours under visual flight rules (VFR).

d. Criteria for Remaining in the Flight Test Area. The UAS PIC must ensure all Sandstorm flight operations remain within the lateral and vertical boundaries of the flight test area. Furthermore, the UAS PIC must take into account all factors that may affect the capability of the Sandstorm to remain within the flight test area. This includes, but is not limited to, considerations for wind, gross weight, and glide distances.

e. Incident/Accident Reporting. Any incident/accident and any flight operation that transgresses the lateral or vertical boundaries of the flight test area must be reported to the FAA within 24 hours. This information must be reported to the Unmanned Aircraft Program Office, AFS-407. AFS-407 can be reached by telephone at 202-385-4322 and fax at 202-385-4651. Accidents must be reported to the National Transportation Safety Board (NTSB) per instructions contained on the NTSB website: www.ntsb.gov. Further flight operations must not be conducted until the incident is reviewed by AFS-407 and authorization to resume operations is provided to USI.

5. Unmanned Aircraft (UA) Pilots and Observers.

a. UA PIC Roles and Responsibilities.

(1) The UA PIC must perform crew duties for only one UA at a time.

(2) All flight operations must have a designated UA PIC. The UA PIC has responsibility over each flight conducted and is accountable for the UA flight operation. The UA PIC will control the local pilot's Radio Controller/Transmitter and maintain visual contact with the UA throughout the flight.

(3) The UA PIC is responsible for the safety of the UA as well as persons and property along the UA flight path. This includes, but is not limited to, collision avoidance and the safety of persons and property in the air and on the ground.

(4) The UA PIC must avoid densely populated areas and exercise increased vigilance when operating in the vicinity of a congested airway in accordance with § 91.319.

b. UA PIC Certification and Ratings Requirements.

(1) The UA PIC must hold and be in possession of, at a minimum, an FAA private pilot certificate, airplane category; with single- or multiengine class ratings, or the military equivalent.

(2) The UA PIC must have and be in possession of a valid second-class (or higher) airman medical certificate issued under 14 CFR part 67, Medical Standards and Certification.

c. UA PIC Currency, Flight Review, and Training.

(1) The UA PIC must maintain currency in manned aircraft by accomplishing three take-off and landings within the preceding 90 days.

(2) The UA PIC must have a flight review in manned aircraft every 24 calendar months in accordance with § 61.56, Flight review, or military equivalent.

(3) The UA PIC must maintain currency in unmanned aircraft in accordance with USI company procedures.

(4) The UA PIC must have a flight review in unmanned aircraft every 24 calendar months in accordance with USI procedures.

(5) All UA PICs must have successfully completed applicable USI training for the UAS.

d. Supplemental UA Pilot Roles and Responsibilities.

(1) During remote pilot operations, the remote pilot will be considered a supplemental UA pilot.

(2) The UA PIC will have operational override capability over any supplemental UA pilots.

(3) A supplemental UA pilot must perform crew duties for only one UA at a time.

e. Supplemental UA Pilot Certification. The supplemental UA PIC need not be a certificated pilot, but must have successfully completed a recognized private pilot ground school program.

f. Supplemental UA Pilot Currency, Flight Review, and Training.

(1) All supplemental UA pilots must maintain currency in unmanned aircraft in accordance with USI company procedures.

(2) All supplemental UA pilots must have a flight review in unmanned aircraft every 24 calendar months in accordance with USI procedures.

(3) All supplemental UA pilots must have successfully completed applicable USI training for the UAS.

g. Observer Roles and Responsibilities. The task of the observer is to provide the UA PIC with instructions to maneuver the UA clear of any potential collision with other traffic. To satisfy these requirements—

(1) The observer must perform crew duties for only one UA at a time.

(2) At no time will the observer permit the UA to operate beyond the line-of-sight necessary to ensure maneuvering information can be reliably determined.

(3) An observer must maintain continuous visual contact with the UA to discern UA attitude and trajectory in relation to conflicting traffic.

(4) Observers must continually scan the airspace for other aircraft that pose a potential conflict.

(5) All flight operations conducted in the flight test area must have an observer to perform traffic avoidance and visual observation to fulfill the see-and-avoid requirement of § 91.113, Right-of-way rules: Except water operations.

h. Observer Certification.

(1) All observers must either hold, at a minimum, an FAA private pilot license or military equivalent, or must have successfully completed specific observer training acceptable to the FAA. An observer does not require currency as a pilot.

(2) All observers must have in their possession a valid second-class (or higher) airman medical certificate issued under part 67.

i. Observer training.

(1) All observers must be thoroughly trained, be familiar with, and possess operational experience with the equipment being used. Such training is necessary for observation and detection of other aircraft for collision avoidance purposes as outlined in program letter.

(2) All observers must have successfully completed applicable USI training for the UAS.

6. Air Traffic Control Provisions

a. Columbia Falls Operations

(1) 24 hours prior to operation, USI shall notify Glacier Park International Tower at (406) 257-0229 and Salt Lake ARTCC Military Operations at (801)-320-2567 and advise the time for commencing and termination of operations. USI will also provide the Notice to Airmen (NOTAM) number for the planned activities.

(2) Glacier Park International or Salt Lake ARTCC may terminate or delay the operation at any time.

(3) The communication and coordination provision in paragraph 6a(1) will be used in lieu of maintaining direct two-way communications with ATC per § 91.129.

b. Malmstrom Operations

(1) 24 hours prior to operation, USI shall notify Great Falls Tower at (406) 454-7504 and advise the time for commencing and termination of operations. USI will also provide the NOTAM number for the planned activities. Advise Great Falls Tower of the experimental nature in accordance with § 91.319.

(2) Great Falls Tower may terminate or delay the operation at any time.

(3) The communication and coordination provision in paragraph 6b(1) will be used in lieu of maintaining direct two-way communications with ATC per § 91.129.

c. Notice to Airman. USI must request the issuance of a NOTAM through the Great Falls Flight Service Station not more than 72 hours in advance, but not less than 48 hours prior to the operation.

7. Communications.

a. Before UA Flights. Before conducting operations, the frequency spectrum used for operation and control of the UA must be approved by the Federal Communications Commission or other appropriate government oversight agency.

b. During UA Flights. All UA positions must maintain two-way communications with each other during all operations. If unable to maintain two-way communication, the UA PIC will remain within the flight test area and conclude the flight operation.

8. Flight Conditions.

a. Daylight Operations. All flight operations must be conducted during daylight hours in visual meteorological conditions (VMC). For operations at Columbia Falls, the aircraft must maintain cloud clearance and flight visibility minimums for Class D airspace, due to the proximity of Glacier Park International airport. For the Malmstrom operation, the aircraft must maintain minimums as specified in § 91.155, Basic VFR weather minimums. Flight operation in instrument meteorological conditions (IMC) is not permitted.

b. Prohibitions.

(1) The UA is prohibited from aerobatic flight, that is, an intentional maneuver involving an abrupt change in the UA's attitude, an abnormal acceleration, or other flight action not necessary for normal flight. (See § 91.303, Aerobatic flight.)

(2) Flight operations must not involve carrying hazardous material or the dropping of any objects or external stores.

(3) Each UA must be operated by only one control station at a time. A control station may not be used to operate multiple UAs.

9. Flight Termination and Lost Link Procedures.

a. Flight Termination. Flight termination must be initiated at any point that safe operation of the UA cannot be maintained or if hazard to persons or property is imminent.

b. Lost Link Procedures. In the event of lost link, the UA will initiate a flight termination maneuver that ensures airborne operations are predictable and that the UA remains within the flight test area.

c. Lost Link Procedures for Columbia Falls, MT.

(1) In the event of a lost link where the UA exits the flight test area, the UAS PIC will immediately notify Glacier Park Int'l. Tower at (406) 257-0229 or Salt Lake ARTCC Military Ops at (801) 320-2567 when Glacier Park Tower is closed, state pilot intentions, and comply with the following provisions:

(a) The pilot and observer will see that the aircraft is unresponsive and monitor its flight path. If the remote pilot is operating at the time, control will be transferred to the local pilot. The local pilot will continue to attempt recovery of the aircraft until the aircraft impacts the ground.

(b) The UA will initiate it's programmed failsafe function in the event of lost link. The function will be set so that the throttle goes to idle, nose gear extends, and the flight surfaces create a slight "up-elevator." The UA is expected to descend in a spiral.

d. Lost Link Procedures for Malmstrom AFB, MT.

(1) In the event of a lost link where the UA exits the flight test area, the UAS PIC will immediately notify Great Falls Tower at (406) 454-7504 and Great Falls Air Traffic Manager at (406) 750-8379, state pilot intentions, and comply with the following provisions:

(a) The pilot and observer will see that the aircraft is unresponsive and monitor its flight path. If the remote pilot is operating at the time, control will be transferred to the local pilot. The local pilot will continue to attempt recovery of the aircraft until the aircraft impacts the ground.

(b) The UA will initiate it's programmed failsafe function in the event of lost link. The function will be set so that the throttle goes to idle, nose gear extends, and the flight surfaces create a slight "up-elevator." The UA is expected to descend in a spiral.

10. Inspection and Maintenance.

a. General Requirements. The UAS must not be operated unless it is inspected and maintained in accordance with USI's Maintenance Program Manual, dated 9/13/2011, or later accepted FAA revision. USI must establish and maintain aircraft maintenance records (see paragraph 10d below).

b. Inspections. Prior to the first flight under the experimental certificate, a condition inspection must be performed according to the FAA-accepted USI Inspection and Maintenance Program. The UAS must be in a condition for safe operation. This inspection will be recorded in the UAS maintenance records as described in paragraph 10d below.

c. Authorized Inspectors. Only those individuals trained and authorized by USI, and acceptable to the FAA, may perform the inspections and maintenance required by these operating limitations.

d. Inspection and Maintenance Records. Inspections and maintenance of the UAS must be recorded in the UAS maintenance records. The following information must be recorded:

(1) Inspection entries must contain the following, or a similarly worded, statement: ***I certify that this UAS was inspected on (date), in accordance with the scope and detail of the USI Inspection and Maintenance Program, and was found to be in a condition for safe operation.***

(2) Maintenance record entries must include a description of the work performed, the date of completion for the work, the UAS's total time-in-service, and the name and signature of the person performing the work.

(3) UAS instruments and equipment required to be installed must be inspected and maintained in accordance with the requirements of the USI Inspection and Maintenance Program. Any maintenance or inspection of this equipment must be recorded in the UAS maintenance records.

(4) The altimeter system must be inspected and maintained in accordance with the manufacturer's instructions.

11. Information Reporting. USI will provide the following information, via email, to donald.e.grampp@faa.gov, on a monthly basis.

a. Number of flights conducted under this certificate.

b. Pilot duty time per flight.

c. Unusual equipment malfunctions (hardware or software).

d. Deviations from ATC instructions.

e. Unintended entry into lost link flight mode that results in a course change.

12. Revisions and Other Provisions.

a. Experimental Certificates, Program Letters, and Operating Limitations. The experimental certificate, FAA-accepted USI program letter, and operating limitations cannot be reissued, renewed, or revised without application being made to the Seattle Manufacturing Inspection District Office (MIDO), in coordination with AIR-200. AIR-200 will be responsible for FAA Headquarters internal coordination with the Aircraft Certification Service, Flight Standards Service, Air Traffic Organization, Office of the Chief Council, and Office of Rulemaking.

b. Certificates of Waiver or Authorization. USI will immediately notify the Production and Airworthiness Division, AIR-200, and the Seattle MIDO, if there is any plan for requesting a Certificate of Waiver or Authorization (COA) for UAS operations during the time the experimental certificate is in effect. An entry in the aircraft logbook is required to document that the aircraft flight authority has been changed from the experimental certificate to a COA. When COA operations are concluded and the aircraft

resumes flying under the experimental certificate, a record entry will be made in the aircraft logbook by an appropriately rated person. This entry will document that the aircraft is in a condition for safe operation and appropriately configured.

c. Amendments and Cancellations. The provisions and limitations annotated in this operational approval may be amended or cancelled at any time as deemed necessary by the FAA.

d. Reviews of Revisions. All revisions to USI's FAA-accepted Inspection and Maintenance Program must be reviewed and accepted by the Helena Flight Standards District Office (FSDO).

13. UAS Modifications.

a. Software and System Changes. All software and system changes must be documented as part of the normal maintenance procedures and must be available for review. All software and system changes must be inspected and approved per USI's Maintenance Program Manual, dated 9/13/2011. All software changes to the aircraft and control station are categorized as major changes, and must be provided in summary form at the time they are incorporated.

b. Major Modifications. All major modifications, including, but not limited to those that could potentially affect the safe operation of the system, must be documented and provided to the FAA before operating the modified aircraft under this certificate. Major modifications incorporated under COA or other authorizations need to be provided only if the aircraft is flown under these authorizations during the effective period of the experimental certificate.

c. Submission of Modifications. All information requested must be provided to AIR-200.

End of Limitations.

Michael Millage — 09/14/2011
Michael Millage
Aviation Safety Inspector
Seattle MIDO, NM-51
Transport Airplane Directorate

Date:

I certify that I have read and understand the operating limitations and conditions that are a part of the special airworthiness certificate, FAA Form 8130-7, issued on 09/14/2011, for the purposes of research and development and market survey.

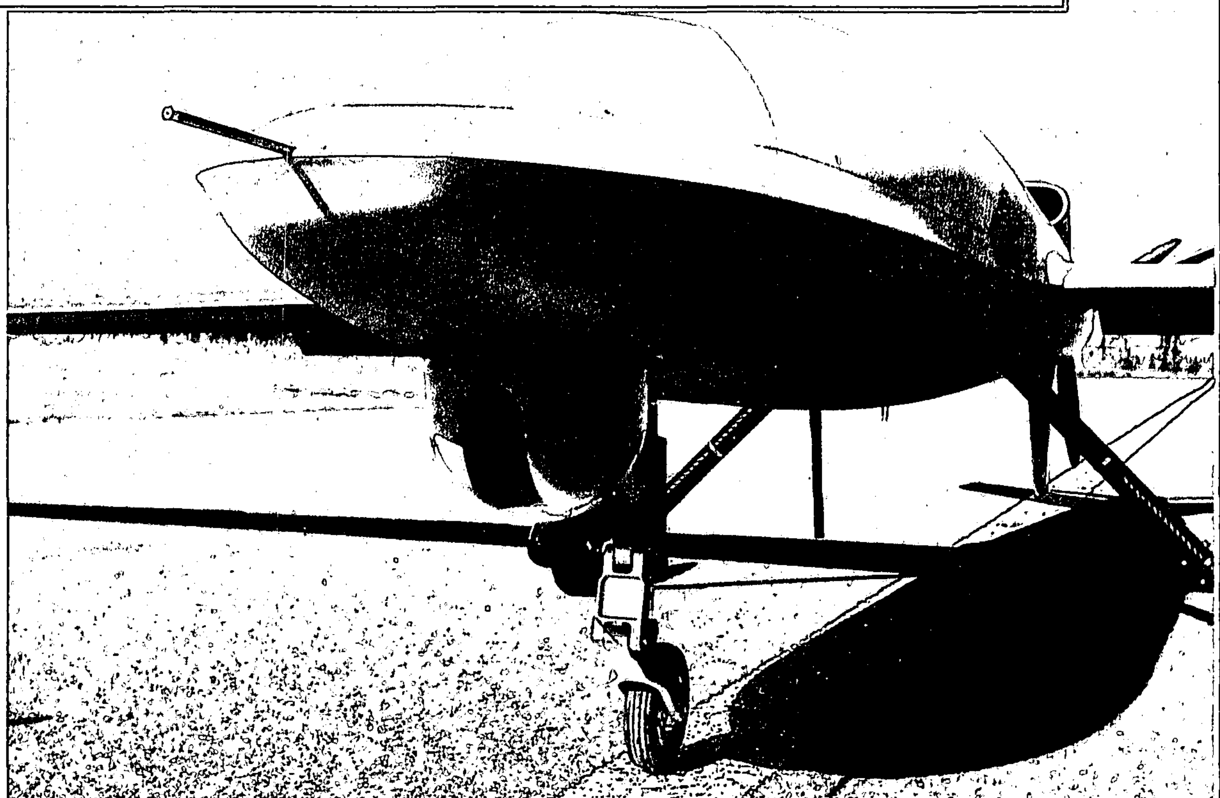
This special airworthiness certificate is issued for the Sandstorm, serial number 11-001E, registration number N441KS.

Donald L Bintz — 09/14/2011
Applicant (signature)
Don Bintz
Chief Executive Officer
Unmanned Systems, Inc.

Date:

2011

Sandstorm™ Program Letter



Unmanned Systems, Inc.

9/13/2011

Contents

Program Letter – Experimental Certificate, Sandstorm™

Registered Owner Name:	**Aircraft Builder:**
Unmanned Systems, Inc.	Sands Concepts
Registered Owner Address:	**Year Manufactured:**
2709 Cyrano Street	2010
Henderson NV 89044	**Aircraft Serial Number:**
Aircraft Description:	11-001E
Sandstorm	**Aircraft Model Designation:**
Unmanned Aircraft	Sandstorm™
Fixed Wing, Electric Prop	**Engine Model:**
Aircraft Registration:	Hacker A60-18L
N441KS	**Propeller Model:**
	Mejzlik Modellbau 21×12

1. Overview of Project.

a. Definition of the Experimental Purpose

There will be two experimental purposes of the Sandstorm™ unmanned aerial system (UAS). The first purpose will be for research and development of the Sandstorm™ UAS, new aircraft operating techniques, and new uses for the aircraft. The second purpose will be to conduct market survey such as sales demonstrations and customer crew training, which shall not be conducted until a minimum of 50 hours of flight time have been accrued. In any case the UAS will be operated in accordance with applicable air traffic and general operating rules of 14 CFR including but not limited to parts 61 and 91 and all additional limitations herein prescribed under the provisions of § 91.319(i), Aircraft having experimental certificates: Operating limitations.

b. Description of the Purpose/Scope of the Experimental Program

The primary vision of the program can be simply stated as developing a companion trainer system (Sandstorm™ UAS, hereafter referred to as *Sandstorm*) in order to ease the significant burden associated with standard training and currency requirements of UAS pilots. Training missions require all the airspace, cost, maintenance, and man-hours associated with flight-testing itself. The risk of accident or damage is daunting. Limited resources, both assets and airspace, and the high demand for operational aircraft diminish training opportunity and quality. Until there are enough resources to meet operational requirements, training will suffer. Because of this, USI seeks to divert the burden associated with training toward a system that can access less congested airspace, is itself orders of magnitude less costly, and does not interfere with the much needed and often limited hours available to operational platforms.

Sandstorm is a small, lightweight, cost effective system that should currently be capable of acting as a basic training platform for UAS crews. USI's primary goal is to research and develop supplemental pilot training using *Sandstorm*.

In addition, USI envisions further developing *Sandstorm* to model the feel and behavior of various other unmanned systems. The goal is a UAS trainer with "tunable" flight characteristics that enable a versatile and progressive learning environment. The concept is similar to most manned flight training that begins in a basic trainer (Cessna 152/172) and then moves on to higher performance aircraft. We therefore seek research and development authorization in order to begin refining *Sandstorm* flight characteristics as well as investigating methods of modeling its flight and control characteristics after other UAS.

If it becomes apparent that *Sandstorm* is a cost effective trainer, USI may make it available to third parties. Institutions of higher learning as well as defense contractors would be the most likely users of *Sandstorm* as an initial UAS trainer. Therefore, USI is also requesting authorization to perform demonstrations and train customer crews.

c. USI Past Flight History and Experience.

USI was created in 2003 to provide unmanned aviation services to the United States Air Force flying the *Predator* MQ-1 UAS at Creech Air Force Base in Indian Springs, Nevada. In 2004 USI was solicited by the Air Force *Predator* program office to augment developmental flight-test operations at Grey Butte, California. Since that time the requirements of the *Predator* program office have grown, both in magnitude and scope, and USI has evolved to meet new program demands. The company has grown from five to over 50 personnel since its inception. USI has also matured from providing support as a sub-contractor to being selected as a sole-source provider by the Air Force Under-Secretary for Acquisition under a National Security Justification and Authorization decree in 2006. Since that time, USI has been a Prime Contractor with the Air Force to perform Developmental and Operational Testing on the MQ-1 *Predator* and MQ-9 *Reaper*. USI also currently employs graduates of both the Air Force Test Pilot School and the National Test Pilot School. All Grey Butte based USI pilots are commercially rated with the majority having backgrounds in both military and general aviation. A significant number are CFII and CFI rated.

2. Definition of Flight Areas.

a/b. Proposed Flight Area/Flight Test Area

1. The primary flight test area is located near Columbia Falls, Montana. The airspace is centered at 48° 15' 56.45" N and 114° 10' 12.00" W and has a radius of 2000 feet and an altitude of 700 feet above ground level (AGL). The primary flight test area is depicted in Figure 1.

2. The primary flight test area includes Sands Airstrip and is located approximately 4.5 nm southeast of Glacier Park International airport (KGPI) and 7.4 nm northeast of Kalispell City Airport (S27). The flight test area includes Class D, E, and G airspace. The western section of the flight test area lies within KGPI's Class D surface area. This airspace reverts to Class E when KGPI's tower is closed. The eastern section of the flight test area is Class G airspace for operations below 700 feet AGL. Class E airspace begins at 700 feet and above in the eastern section. The Class D airspace is under the jurisdiction of KGPI's tower during operating hours. Otherwise, when the KGPI tower is closed, the Class E airspace is under the jurisdiction of Salt Lake Air Route Air Traffic Control Center (ARTCC).

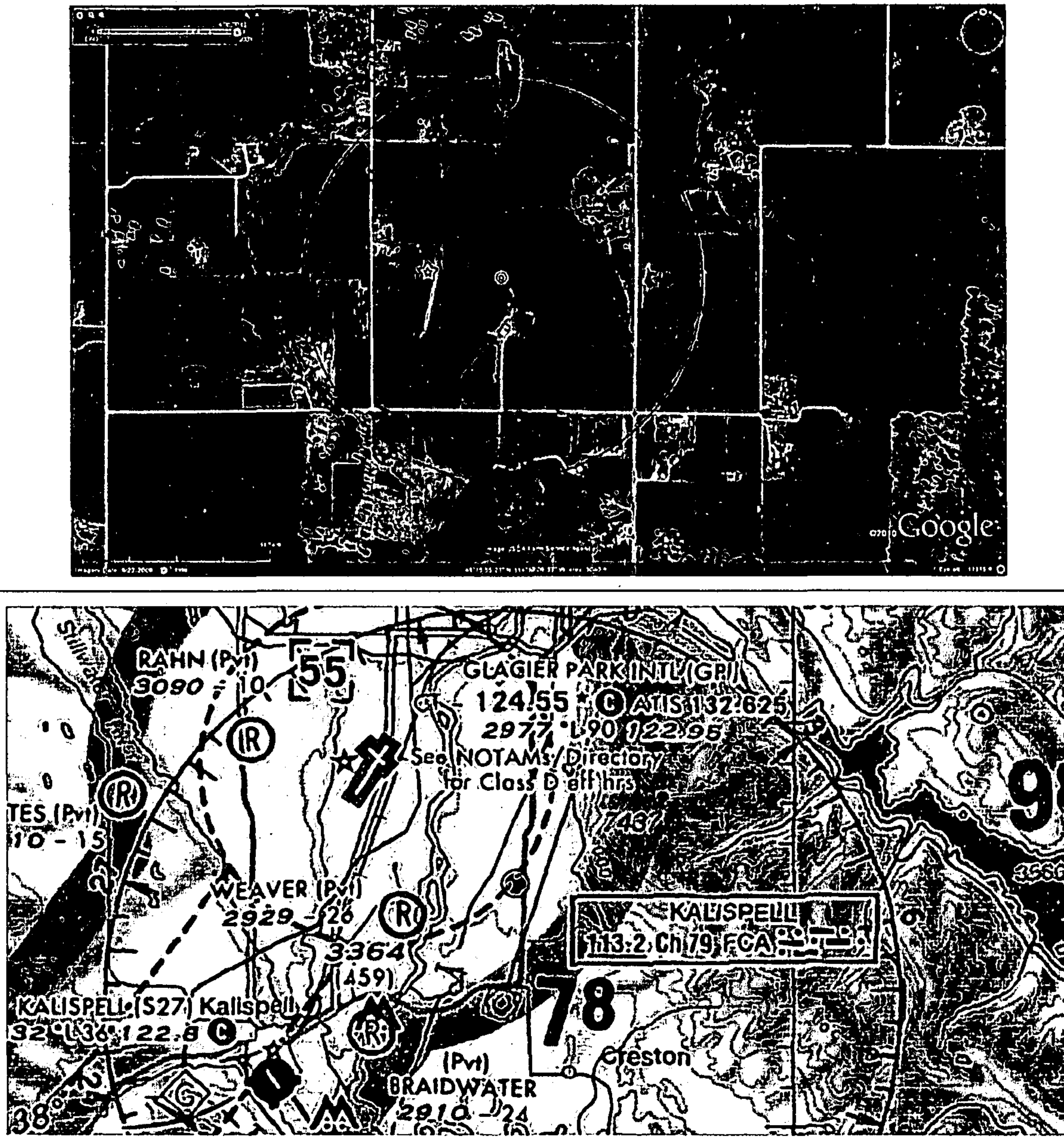


Figure 1. Proposed Flight Area 1, Sands Airstrip. Top--The star indicates the location of the base of operations, Sands Hangar. The bull's-eye indicates the center of the proposed airspace (indicated in red). Bottom—VFR Sectional, red circle indicates the proposed area of operations.

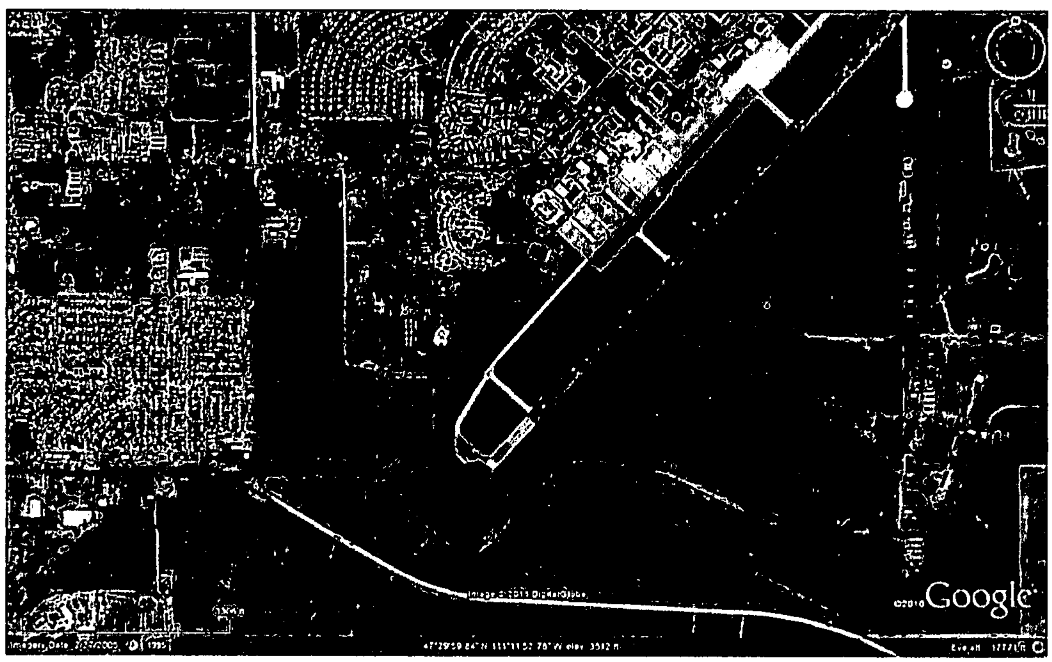
1. A secondary flight test area is located at Malmstrom AFB, Montana. The airspace is 7,419 feet long and 3000 feet wide up to an altitude of 700 feet AGL. This flight test area is depicted in Figure 2.

Northwest corner	**47° 30' 38.33" N 111° 11' 1.70" W**
Northeast corner	**47° 30' 18.38" N 111° 10' 29.40" W**

Southeast corner	**47° 29' 24.16" N 111° 11' 42.00" W**
Southwest corner	**47° 29' 44.1" N 111° 12' 14.25" W**

2. The Malmstrom flight test area includes airspace over the southern part of the closed runway. The Sandstorm may operate from this closed runway or the parking ramp as long as the takeoff and landing surface lies within the coordinates above. Furthermore, the Sandstorm must also remain within 2000 feet from the point where it initiated its takeoff roll. The Great Falls International Airport (KGTF) is located approximately 7 nm west of the flight test area. The Malmstrom flight test area includes Class E and G airspace.

3. This flight test area is only authorized for a one-time use market survey event hosted by Montana State Senator Ryan Zinke.



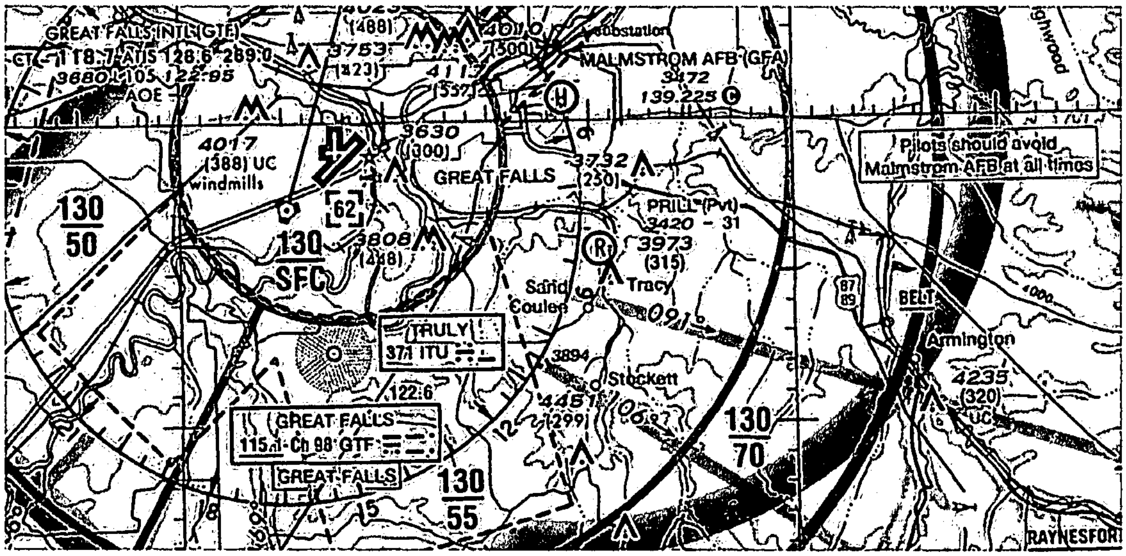


Figure 2. Proposed Flight Area 2, Malmstrom AFB

c. Airspeed, altitude, number of flight hours, number of flights, and program duration for each test flight area:

i. Cruise airspeed. 40 – 60 kts
ii. Maximum airspeed. 100 kts (dash)
iii. Maximum altitude. 700 ft above ground level
iv. Number of flight hours. 30 hours per month
v. Number of flights. 30 flights per month
vi. Program duration. 1 year

d. The proposed airspace includes Class D, E and G at Sands Airstrip (48°15'56.45"N, 114°10'12.00"W) near Kalispell, MT. A portion of proposed OPAREA lies within Glacier Park Int'l Class D surface area (Class E when Tower closed). Remainder is Class G airspace for operations below 700' AGL (Class E begins at 700' and above). The proposed airspace is under jurisdiction of Glacier Park Int'l Tower and Salt Lake ARTCC (Air Route Air Traffic Control Center).

e. There are no minimum fuel requirements because the UA is battery powered.

f. There will be no payload testing.

g. No payload considerations

h. The aircraft will not perform aerobatic maneuvers.

i. Flight conditions: VFR; VMC

3. Aircraft Configuration

a. Wing span. 15 ft

b. Length. 100" from tip of Pitot tube to tip of spinner cone.

c. Power plant. Electric motor, Hacker A60-18L, 2600W, 90A

d. Maximum gross takeoff weight. 70 lb

e. Fuel capacity. N/A

f. Payload capacity. *Sandstorm* carries a commercially available camera on the underside of the front portion of the fuselage. This is the only configuration planned for this experimental certificate. There will be no other payload.

g. Maximum altitude. Not determined.

h. Endurance. 35 minutes (motor battery limited)

i. Maximum airspeed. 100 kts

j. Control/data frequencies. 2.4 GHz ISM

k. Guidance and navigation control. The pilot provides guidance and navigation.

The Unmanned Aerial System (UAS). *Sandstorm* is a relatively small-scale system requiring very little in the way of maintenance, inspections, or systems coordination in order to operate. Weighing in at less than 40 lb, the *Sandstorm* unmanned aircraft (UA) is a battery operated pusher prop plane that is easily rolled out onto the airstrip by hand. Maintenance and inspection associated with engines and fuel tanks is nonexistent. Other than battery chargers, its ground support system includes controls and signal processing components that sit on a basic utility cart. The Pilot in Command (PIC) operates the aircraft using a hand held controller—standing adjacent to the takeoff site and maintaining visual line of sight of the aircraft at all times. There are no chase planes—the proposed airspace will limit the horizontal travel and altitude to visual line of sight capabilities. A USI employee owns much of the surface area under the proposed flight test area. In sum, we believe the system is inherently low-maintenance, safe, and straightforward to operate.

What is unique about the *Sandstorm* UAS is that the UA can be controlled by a secondary command/data link via the Internet. Figure 3 illustrates the process. Using specific expertise and proprietary technology, USI has been able to shorten the interval required to convert command and video signals to Internet protocol (IP) compatible language to, in effect, real time. The video feed from the onboard camera, in the form of a first person view (FPV) with overlaid telemetry (similar to a heads up display), is transmitted over the Internet to a specific IP address associated with a secondary (remote) pilot's local area network. The FPV video and telemetry is then displayed for the remote pilot. The remote pilot responds to this display by manipulating a joystick whose signals are transmitted back over the Internet to the aircraft. The total delay from the transmission of the video feed to the receipt of the remote pilot's control inputs at the aircraft is less than 70 ms. This delay compares favorably with current operational remotely piloted platforms.

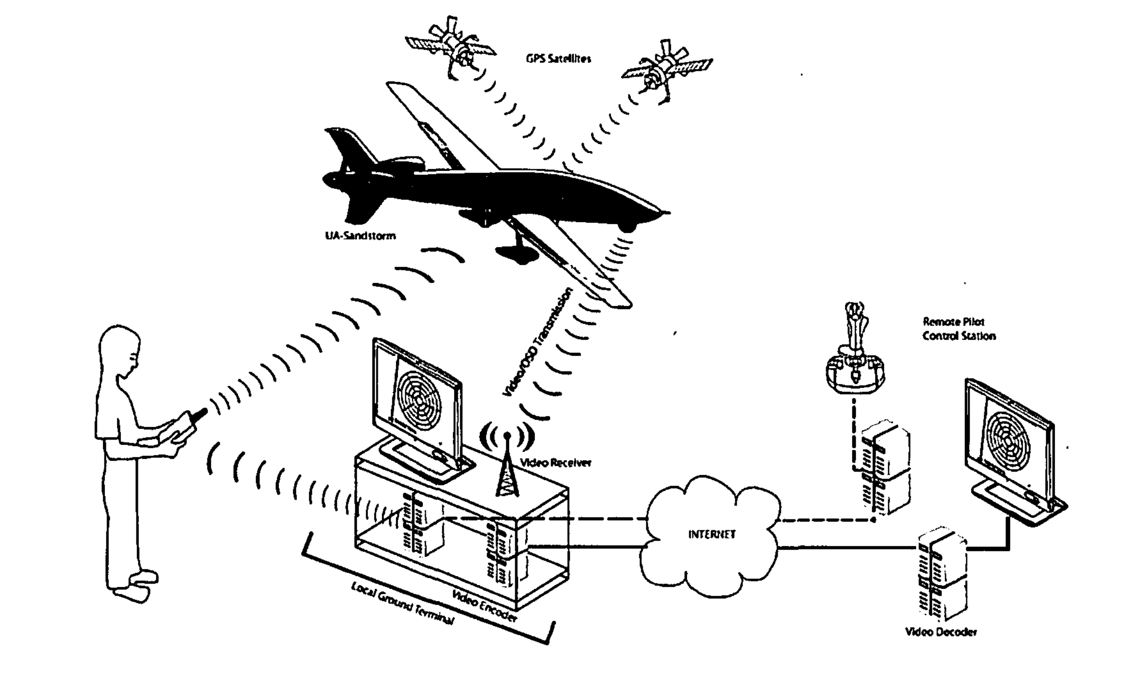


Figure 3. ***Sandstorm*** **Unmanned Aerial System (UAS) In Flight Process.**

A critical consideration when using the Internet to control a UAV is safety and risk management. We believe our strategy to mitigate any risk and conduct these operations safely is very thorough. To begin with, the local pilot control station (operated by the PIC) always has priority over the Internet relayed signal. The PIC, who stands adjacent to the hangar and remains in line of sight with the aircraft, has instant access to the UA controls and is in charge of giving control of the UA to the remote pilot. Continuous depression of a "buddy box" button on the PIC controller is what enables the remote pilot signal to transmit to the aircraft. When the button is up, the PIC circuit is completed; when down, the remote pilot circuit is completed. When the PIC releases that button, the signal from the remote pilot is immediately cutoff or muted by the PIC inputs. Central to the safe operation of this system is our requirement that the PIC remain in constant line of sight of the aircraft, audio communication with the remote pilot, and readiness to take control of the aircraft. The setup is similar to the situation of an Instructor Pilot and Student where the Instructor is able to take control of the aircraft at any time.

In addition to PIC priority, the system makes use of an observer whose main role is to see and avoid other aircraft and potential hazards in the proposed flight area. The observer and local pilot remain within speaking distance of each other. The local pilot and remote pilot maintain audio communication using telephones. If the observer notifies the local pilot of a hazard, the local pilot can immediately assume control of the aircraft.

Similarly there is never a circumstance where the remote pilot is recovering an aircraft that has lost link.

Also part of USI risk mitigation strategy are the multiple redundancies in power supply and signal link built into the system. These redundancies are detailed herein as well as within the *Sandstorm* Safety Checklist.

Sandstorm components are discussed in further detail below. In brief, the UAS requires very little in the way of ground support equipment and control station components. As previously mentioned, the UA is battery powered, eliminating much of the ground support equipment required for other UAS. The hangar is equipped with basic tools, battery chargers, a balancer, and spare parts. The local control station sits on a small utility cart that holds the monitor, signal conversion components, and video receivers. The cart is rolled out of the hangar and sits adjacent to the local pilot during flight.

The Unmanned Aircraft (UA). The UA itself is a single wing, all composite, battery powered "pusher prop" aircraft with high aspect-ratio wings, a Y-form tail, and tricycle landing gear utilizing a fixed main unit and retractable nose unit. The UA measures 15' X 8' and weighs less than 40 lb. **Figure 4** depicts detailed measurements.

The *Sandstorm* propeller is powered by a Hacker electric motor. It is equipped with a solid state digital Electronic Speed Control (ESC) that operates on a discreet battery system and exhibits automatic shut-off in the event of high current or low voltage. The ESC is capable of 160 A, which is more than 2.5 times the 59 A the system uses. A photograph showing the motor and ESC is shown in **Figure 5**.

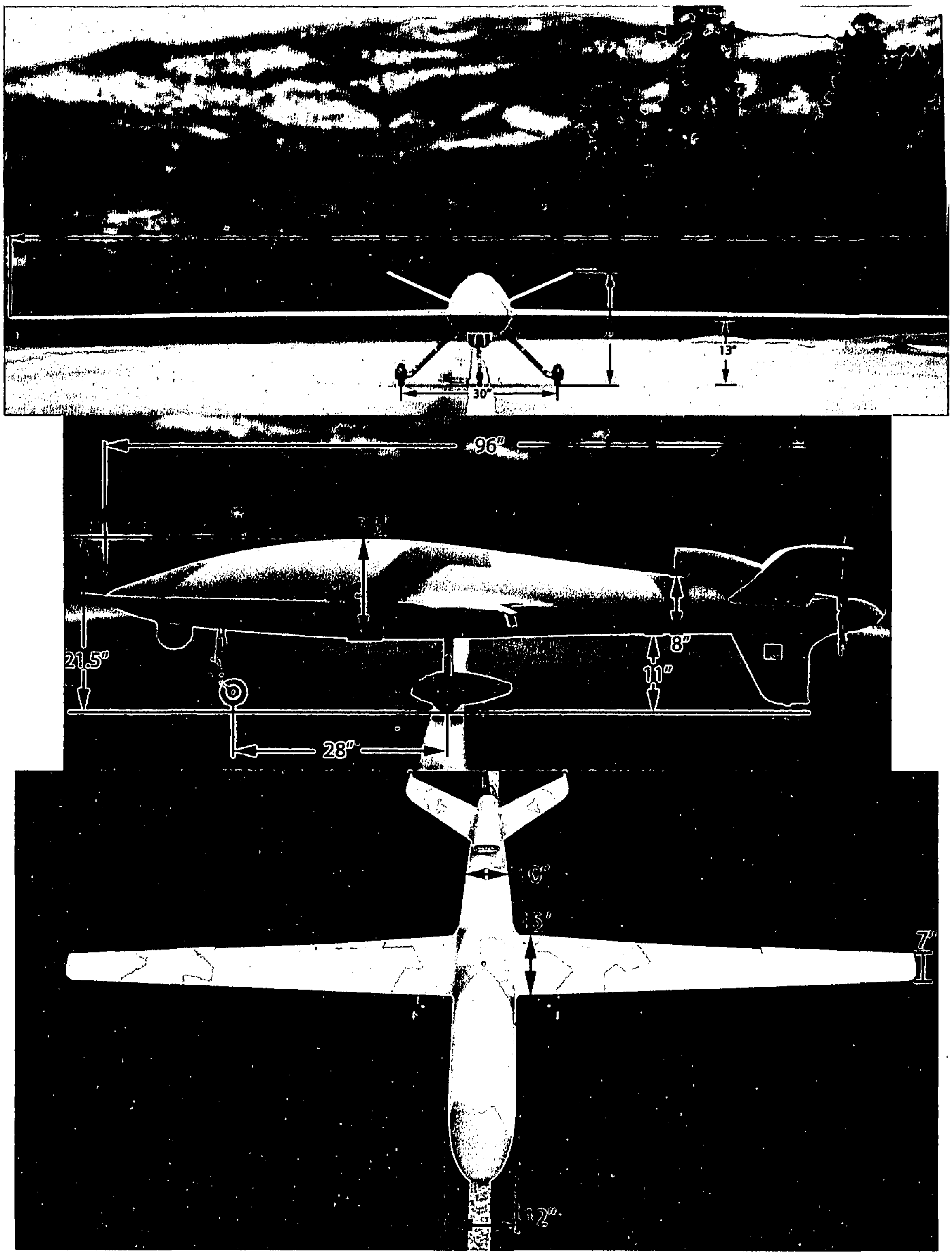


Figure 4. 3-View Dimensioned Photographs of the *Sandstorm* UA.

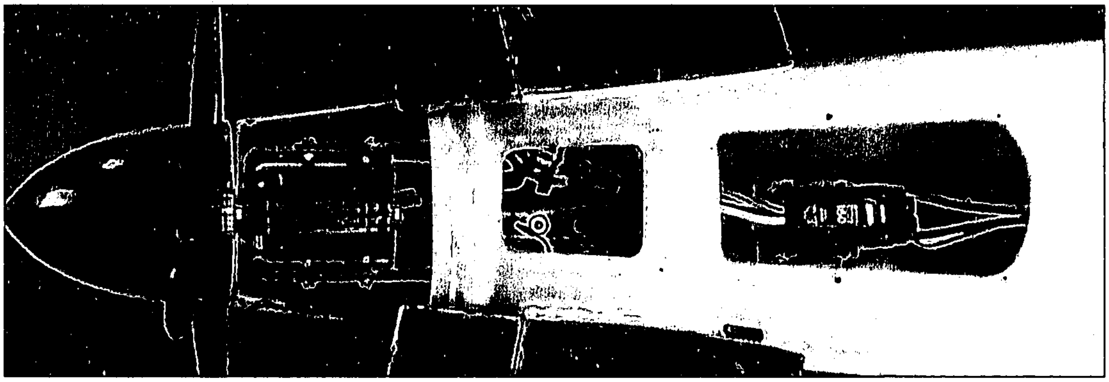


Figure 5. UA Motor and ESC configuration.

Control of the aircraft is achieved using a JR 1222 Power Safe Receiver/Controller (small black component to the right of the orange wires (servos) in Section "R/C", **Figure 6**) that accommodates up to 10 servos, is supplied by redundant Lithium Polymer (LiPo) lightweight batteries and transmits and receives data via four redundant wireless (remote) receivers located in various positions throughout the aircraft. The remote receivers process data completely independently of one another so that any single one is capable of transmitting the entirety of control commands to the 1222 Controller. They also work in union so that consecutive data packets can be gathered randomly from the four receivers.

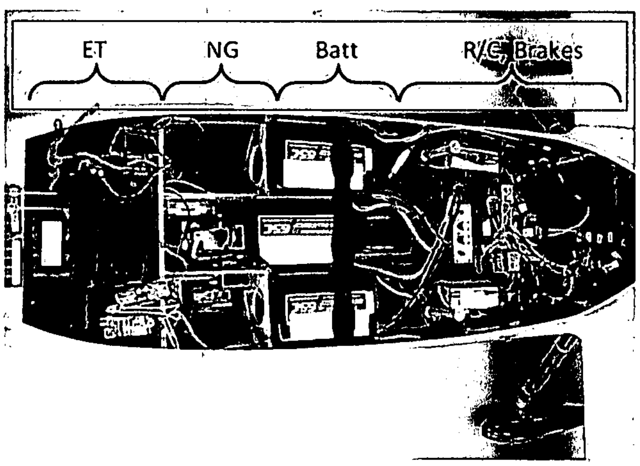


Figure 6. Top View of UA Nose Contents. ET—Eagle Tree, NG—Nose Gear, Batt—LiPo Batteries, R/C—Receiver/Controller, Brakes—Brake controls and air.

The *Sandstorm* UA is also equipped with a data logging system (Eagle Tree eLogger v4) and an accompanying on screen display module (Eagle Tree OSD-Pro) that transmits on screen display (OSD) telemetry and video data to the pilot control stations via a 5.8 GHz DSSS transmitter. Section "ET" in **Figure 6** includes, from the bottom up, the eLogger board, the OSD module, the Eagle Tree battery supply, and the Eagle Tree transmitter. The Eagle Tree system receives telemetry inputs from various probes located throughout the aircraft (temperature, airspeed, wind speed, rpm, etc.) which are shown coupling to the bottom-most board in the ET section of **Figure 6**.

An additional data logger is also located on board the aircraft (small red box in section R/C Brakes of **Figure 6**). The purpose of this additional data logger is to monitor the rate of data transmission to and from the controller. Each of the four redundant receivers should typically

receive 45 packets of information per second (Pkt/s). The logger records the rate of data transmission as well as "Fades" and "Holds". A Fade is a single missing packet on all four receivers simultaneously. A Hold is 45 consecutive Fades, which is one second of missing data. These data are analyzed after each flight.

The pneumatic system onboard the *Sandstorm* UA includes both the nose gear and the brakes. Section "NG" in **Figure 6** includes a top view of the nose gear system. The air canisters that supply the gear and brakes sit beneath the LiPo batteries and are filled using the magenta colored ports seen in the middle of the "R/C Brakes" section of **Figure 6**.

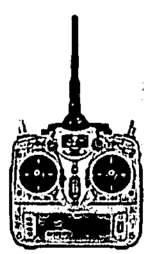
The section labeled "Batt" in **Figure 6** includes the three LiPo batteries that supply the motor and ESC.

The ground based hardware associated with the *Sandstorm* UAS includes a Local Ground Terminal (LGT) and two Pilot Control Stations.

Local Ground Terminal (LGT). The local ground terminal is a relatively small utility cart that is rolled out of the hangar and sits adjacent to the PIC during flight. It houses a display screen for the local pilot (aka PIC) as well as signal converter hardware and radio equipment. **Figure 3** illustrates the different components associated with the local ground terminal.

Pilot Control Stations. There are two pilot control stations, the local pilot control station and the remote pilot control station. Both display real-time first-person-view (FPV) image with overlaid telemetry data (similar to a HUD).

A



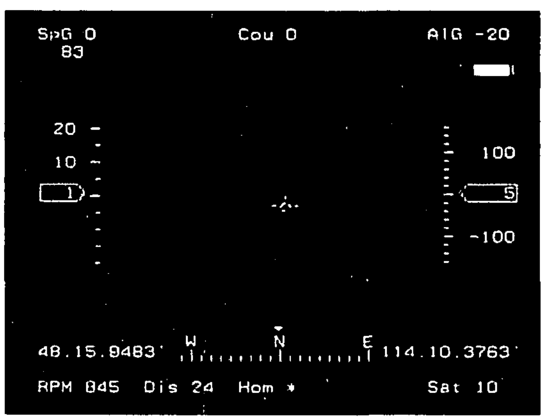


Figure 7. Local Pilot Control Station Components. Left) JR 12X Radio Controller. Right) FPV on screen display showing telemetry.

Local Pilot Control Station. The dominant control station belongs to the local pilot. The local pilot utilizes a handheld JR 12X Radio Controller/Transmitter (Left, **Figure 7**) to fly the UA.

This controller has been custom modified to receive and transmit the 2.4 GHz DSSS signal from the remote pilot to the UA. At the back of the JR 12X, a 6-channel (JR AR6205) receiver has been hard wired into the controller's trainer interface (the back panel unscrews for access). R/C hobbyists use this interface to teach new users. A "slave" controller works in tandem with the "master". The master operator depresses a "buddy box" or trainer button in order for the slave to transmit. *Sandstorm*, however, sends p-link data via this trainer interface. USI has custom coded the AR6205 to receive synchronized data packets from the remote pilot (via a local transmitter, discussed below) and feed them into the 12X where they are subsequently transmitted to the aircraft whenever the buddy box button is depressed.

The 12X holds an FCC ID number (BRWDAMTX10) that corresponds to modular approval. This allows changes to be made as long as they do not affect the 12X RF module. The modifications used here only affect the trainer interface. The power source for the AR6205 is the internal 12X 9V supply. This does not impact the RF module.

The video feed and OSD/telemetry from the aircraft is also displayed for the local pilot as part of the local pilot control station. This information is displayed on a monitor that sits on the LGT cart and gives the local pilot better situational awareness and an ability to see what the remote pilot sees. A screen capture of a similar display is shown on the right in **Figure 7**. OSD data includes speed, altitude, the current and voltage of the ESC, distance from home, long/lat, temperature, GPS health, heading, up to three waypoints, and a home point.

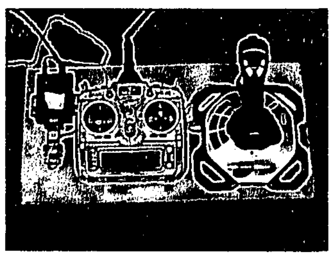


Figure 8. Remote Pilot Control Station (Video Decoder and monitor not shown).

Remote Pilot Control Station. The remote pilot control station includes a monitor, signal conversion hardware, and joystick controller. The monitor is used to provide the remote pilot with the first person video image as well as overlaid telemetry and OSD data. The signal converter hardware includes a video decoder to re-create the video signal after Internet transmission, and the control signal converters to prepare the remote pilot's control commands for Internet transmission. When given control, the remote pilot operates the aircraft using a Logitech Joystick that combines pitch, roll, and yaw inputs in one controller. **Figure 8** shows the joystick used. Also shown is a second controller that is a component of the signal conversion process. The signal from the joystick needs to be converted to separate elevator, aileron, and throttle feeds and the middle radio shown in **Figure 8** is used to perform this conversion. The signals are then routed through additional converters, shown on the left, which translate the information to Internet protocol compatible feeds that are subsequently transmitted over the Internet.

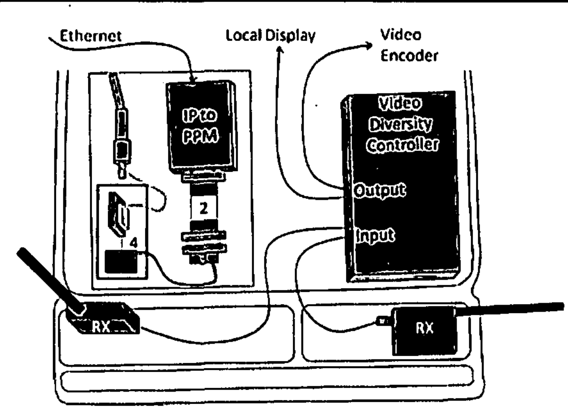


Figure 9. Local Ground Terminal Cart. Top rack contents (display monitor not shown).

Video and Control Link, and Latency. The entire loop from aircraft to remote pilot and back again includes several signal processing steps. Starting at the aircraft, the video feed, with the OSD/telemetry data burned in, is transmitted via radio to the local ground terminal. **Figure 9** depicts a portion of the video link pathway (as well as part of the control link) located on the top shelf of the local ground terminal. **Figure 10** diagrams the video and telemetry/OSD pathway in full. Two separate receivers, oriented orthogonally, shown on the bottom left and right of **Figure 9**, are the gateway to the video link. The feeds from these receivers are routed through a video diversity controller, which allows the better quality signal to pass through to two output ports. One output from the diversity controller goes directly to the local display, generating the OSD and first person video for the local pilot. The other output travels to the Video Encoder on the lower shelf of the local ground

terminal (not shown). The Video Encoder uses a standardized encoding process (H.264) to sample and compress the video/OSD feed into Internet protocol (IP) compatible language. The output of the Video Encoder travels over Ethernet cable

through a router to the Internet. The data bears an IP address that directs it to the remote pilot control station where it is received and reconstructed by the Video Decoder and then displayed on the remote pilot's monitor. Transmission of the video feed from the UA to the remote pilot display takes approximately 24.5 ms.

From the bottom up in **Figure 10**, the control signal from the remote pilot controller is first converted to IP compatible data. Next it is transferred through the remote pilot control station router, over the Internet, and back to the local pilot control station router. This router is located on the bottom shelf of the local ground terminal. The signal is then fed over an Ethernet cable to the top shelf where it is processed back to command language.

The hardware for converting IP signals to commands is depicted on the left in **Figure 9**. The remote signal conversion hardware is identical in appearance but inverted in purpose (photographed on the left in **Figure 8**). There are three steps to the signal conversion on each end of the control link path. At the local end, the signal is converted from the IP input to a pulse position modulation (PPM) signal. The output of this goes directly into a microprocessor that converts the PPM signal to serial (#2, **Figure 9**). A second microprocessor (#3, **Figure 9**) then converts the serial signal to a signal that can be recognized by the DSM2 transmitter (#4, **Figure 9**). It takes 120 μs for the signal to be converted from IP to serial. After an additional 620 μs, the signal is transmitted to the aircraft (see the timeline in **Figure 10**). The microprocessors involved in the signal conversion and transmission deliver data at a rate of 45 packets per second (Pkt/s), the equivalent of 5760 bytes per second (Bps).

Once the signal has been converted to DSM compatible data, it is transmitted from the local ground terminal to the local pilot's radio controller. If the local pilot has the Buddy Box button depressed, the signal is transmitted from the local pilot's controller to the aircraft. The typical delay between the remote pilot control inputs and the radio transmitter on the LGT is approximately 5.4 ms, which is significantly less than the delay for many operational remotely piloted UAS.

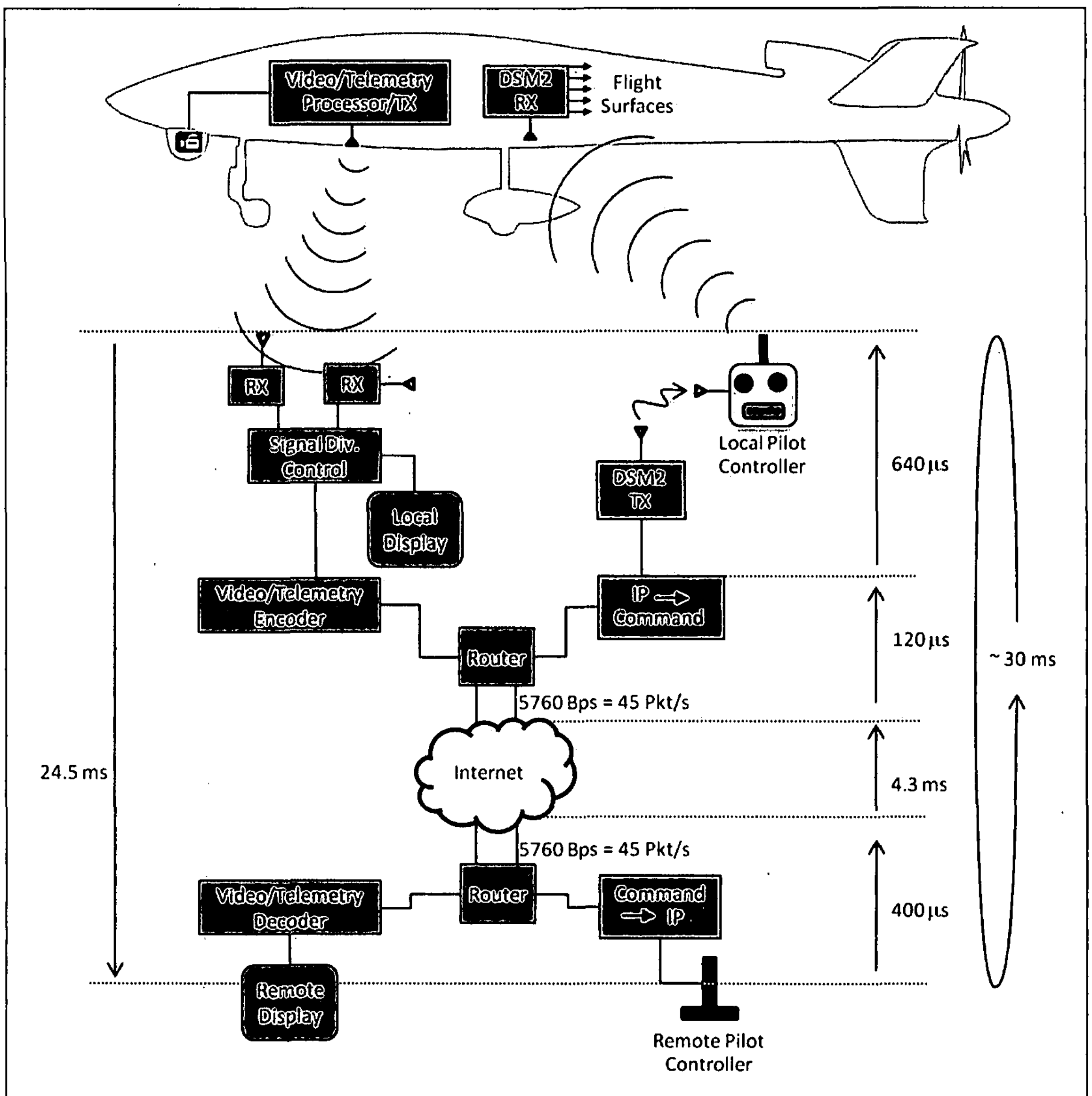


Figure 10. Control and Video Link Architecture and Latency. 1000 μs = 1 ms

4. Inspection and Maintenance

a. Description of the Program.

A detailed *Sandstorm* Maintenance Program is included in the *Sandstorm* Maintenance Program Manual.

b. Required Documentation.

The current weight of the *Sandstorm* UA is 35 lb. Its center of gravity is located 4.25" anterior to the leading edge of the wing at its root.

An equipment list for *Sandstorm* can be found in the maintenance records.

A *Sandstorm* flight manual is under development.

5. Pilot Qualification

a. **Current Pilot Certifications (see training records).**

b. **Medical Certifications (see training records).**

(1) The UA PIC must hold and be in possession of, at a minimum, an FAA private pilot certificate, airplane category; with single- or multiengine class ratings, or the military equivalent.

(2) The UA PIC must have and be in possession of a valid second-class (or higher) airman medical certificate issued under 14 CFR part 67, Medical Standards and Certification.

c. Pilot Training.

During the initial phase of *Sandstorm* development, pilots must demonstrate proficiency in pattern operations, basic maneuvering, and unusual attitude recovery.

(1) The UA PIC must maintain currency in manned aircraft in accordance with § 61.57, Recent flight experience: Pilot in command.

(2) The UA PIC must have a flight review in manned aircraft every 24 calendar months in accordance with § 61.56, Flight review.

(3) The UA PIC must maintain currency in unmanned aircraft in accordance with USI company procedures.

(4) The UA PIC must have a flight review in unmanned aircraft every 24 calendar months in accordance with USI procedures.

(5) All UA PICs must have successfully completed applicable USI training for the UAS.

d. Supplemental Pilot.

During remote pilot operations, the remote pilot will be considered a supplemental pilot.

e. Qualifications and Training of Observers.

Observer training is required for observers to communicate to the pilot any instructions required to remain clear of conflicting traffic. All observers must successfully complete applicable USI training for the UAS. Acceptable observer training as a minimum must include, but is not limited to, knowledge about the following—

(1) The Observer for *Sandstorm* will hold as a minimum a private pilot license and therefore understand Part 91.111, 113 and 155.

(2) Observers will hold as a minimum a Private pilot's license and therefore understand radio communications and approved phraseology.

(3) Pilot rating will have covered the AIM and its applicability. Also, USI will have an independent training program for Observers to include a local area orientation and standard terminology.

(4) All observers must be thoroughly trained, be familiar with, and possess operational experience with the equipment being used. Such training is necessary for observation and detection of other aircraft for collision avoidance purposes as outlined in program letter

6. Aircraft Registration and Identification Marking

The *Sandstorm* UA has been registered and marked according to 14 CFR 45 as shown in **Figure 11** below. The word "Experimental" was added to both sides of the fuselage after the date of the image shown.

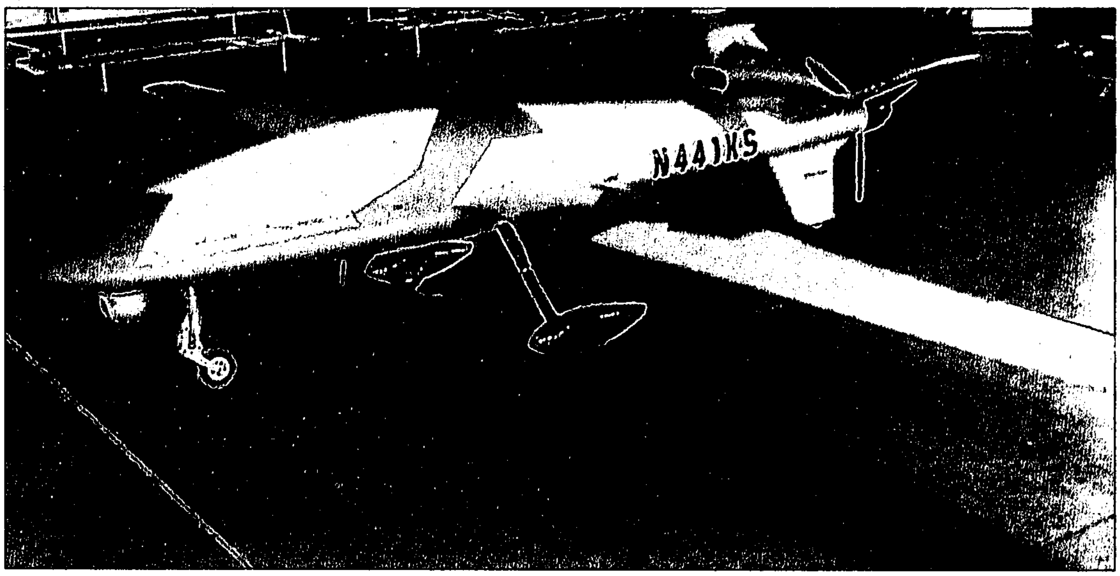


Figure 11. *Sandstorm* N Number.

7. ATC Transponder and Altitude Reporting System Equipment and Use

Sandstorm does not utilize a transponder.

8. Method for See-and-Avoid

The aircraft will be kept in visual line of sight of the ground observer and local pilot. The observer will provide see and avoid capability to the local and remote pilot.

9. Safety Risk Management

Safety risk management is discussed in the *Sandstorm* Safety Checklist.

10. System Configuration

A complete description of system configuration is provided above (section 3. Aircraft Configuration

11. System Safety—Flight Termination and Lost Link

In the event the *Sandstorm* UA loses motor power, the JR 1222 receiver remains operational and the aircraft can be controlled by the pilot as a glider.

In the event of a lost link, the UAS PIC will immediately notify Glacier Park Int'l. Tower at (406) 257-0229 or Salt Lake ARTCC Military Ops at (801) 320-2567 when Glacier Park Tower is closed, state pilot intentions, and comply with the following provisions:

1. The pilots will see that the aircraft is unresponsive and monitor its flight path.
2. If the remote pilot is operating at the time, control will be transferred to the local pilot.
3. The local pilot will continue to attempt recovery of the aircraft until the aircraft impacts the ground.

In the event of a lost link, the *Sandstorm* UA receiver is equipped with a programmable failsafe function. This function has been set so that throttle goes to idle, nose gear extends, and the flight surfaces create a slight "up-elevator" whenever the link is lost for more than one second (this occurs regardless of stage of flight). This results in a spiral descent of the UA. The local pilot visually determines that a lost link condition has occurred by observing the descent of the nose gear and the loss of UA response to control inputs. The remote pilot will also have determined that control has been lost. Graceful degradation of the observed control system response and low link quality warnings are used as an early indication of degraded link quality and a potential for a lost link conditions.

Failsafe functionality is checked during every Pre flight. The nose of the aircraft is held off the ground by weighting the tail and the nose gear is retracted. The transmitter is then shut off for more than 1 second. This activates the failsafe logic of the 1222 receiver. Observation of the flaps, gear, and control surfaces moving to the appropriate settings verifies the system is operational.

The current version of *Sandstorm* does not exhibit a return to home function or other flight recovery system.

a. Flight Termination. Flight termination will be initiated at any point that safe operation of the UA cannot be maintained or if hazard to persons or property is imminent.

b. Lost Link Procedures. In the event of lost link, the UA will initiate a flight termination maneuver that ensures airborne operations are predictable and that the UA remains within the flight test area.

c. Lost Link Procedures for Columbia Falls, MT.

(1) In the event of a lost link where the UA exits the flight test area, the UAS PIC will immediately notify Glacier Park Int'l. Tower at (406) 257-0229 or Salt Lake ARTCC Military Ops at (801) 320-2567 when Glacier Park Tower is closed, state pilot intentions, and comply with the following provisions:

(a) The pilot and observer will see that the aircraft is unresponsive and monitor its flight path. If the remote pilot is operating at the time, control will be transferred to the local pilot. The local pilot will continue to attempt recovery of the aircraft until the aircraft impacts the ground.

(b) The UA will initiate its programmed failsafe function in the event of lost link. The function will be set so that the throttle goes to idle, nose gear extends, and the flight surfaces create a slight "up-elevator." The UA is expected to descend in a spiral.

d. Lost Link Procedures for Malmstrom AFB, MT.

(1) In the event of a lost link where the UA exits the flight test area, the UAS PIC will immediately notify Great Falls Tower at (406) 454-7504 and Great Falls Air Traffic Manager at (406) 750-8379, state pilot intentions, and comply with the following provisions:

(a) The pilot and observer will see that the aircraft is unresponsive and monitor its flight path. If the remote pilot is operating at the time, control will be transferred to the local pilot. The local pilot will continue to attempt recovery of the aircraft until the aircraft impacts the ground.

(b) The UA will initiate its programmed failsafe function in the event of lost link. The function will be set so that the throttle goes to idle, nose gear extends, and the flight surfaces create a slight "up-elevator." The UA is expected to descend in a spiral.

12. Command and Control

Procedurally, Command and Control of Sandstorm is analogous with a conventional manned flight during basic training and test, or demonstration scenarios. All flights are based on a planned or scripted series of flight maneuvers to complete a set of objectives. These maneuvers will have parameters to ensure compliance with boundaries and limitations. There is not currently any autonomous flight capability. During flight operations the local pilot or the remote pilot manipulates flight controls that send signals to the aircraft. The systems used to send commands and move the flight control surfaces are described in section 3. Aircraft Configuration. Direct control of the aircraft is accomplished through a feedback loop between the aircraft and the local/remote pilot. A pilot makes inputs to the flight controls and observes the aircraft respond. The pilot then adjusts inputs based on what the aircraft does. The pilots are on the ground using one of two visual reference perspectives. The local pilot, the primary controller, and is watching the aircraft from the launch point just as a recreational (R/C) flyer would. The remote pilot uses a video feed, which provides a real-time first person view from the aircraft with an on screen display (similar to a HUD) for attitude, performance and navigation cues.

13. Control Stations

A complete description of the control stations is provided in section 3. Aircraft Configuration.

14. Control Frequencies.

The UAS local radio frequency (RF) link uses the 2.4GHz ISM band. Spectrum coordination is not required. A combination of frequency hopping and direct sequence spreading is used to mitigate collisions from interfering systems.

The data link margin is 113dBm. This is derived from the RF gain and noise figure of the antenna, transmitter and receiver system. In addition, the processing gain of the DS spreader is also taken into consideration.

The unlicensed ISM band has spreading requirements for US and worldwide type approval. *Sandstorm*'s RF link exceeds these requirements.

15. Crew Resource Management

A description of crew resource management including Situational Awareness and Standard Terminology in Normal and Emergency Procedures is included in the Flight Crew Training Program.

Aircraft Weight and Balance

Tail Number: **N441KS**			09/01/2011
Prepared by: Justin Sands SandsConcepts 1375 Middle Rd Colombia Falls MT, 59912			
Aircraft Make: **Unmanned Systems**	Model: **Sandstorm**	Serial No: **11-001E**	Time: N/A
Registered Owner: **Don Bintz**		Address: 2709 Cyrano Ave Hendersen NV, 85933	
Basic Weight: **38.3 lbs**		Center of Gravity: 43.25 in	
Previous weight and balance: N/A		Prev Wgt:	Prev CG:

Notes: This the initial weight and balance calculation for USI Sandstorm (Serial No: 11-001E). This is a "fixed" configuration aircraft. There is no useful payload. Loading does not vary with each flight.

Added / Change equipment or Stores:	**Weight**	**Arm**	**Moment**
N/A	N/A	N/A	N/A

	As Calculated	Moment 1656.48	CG 43.25
X	As Weighed	Weight 38.3	

Signed: [signature]
Certificate #: