ELKHORN SLOUGH
TECHNICAL REPORT SERIES 2020: 4

Sponsored by the Elkhorn Slough National Estuarine Research Reserve and the Elkhorn Slough Foundation

Unoccupied Aerial Systems: Procedures Manual

John Haskins

Nov 2020

Elkhorn Slough National Estuarine Research Reserve

CALIFORNIA DEPARTMENT OF FISH & WILDLIFE

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

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HOW TO CITE THIS DOCUMENT

The appropriate citation for this document is:

Haskins, J. C. 2020. Unoccupied Aerial Systems: Procedures Manual. Elkhorn Slough Technical Report Series 2020:4. Available at http://www.elkhornslough.org/research-program/technical-report-series/

AUTHOR AFFLIATION

John Haskins conducted this work as staff for Elkhorn Slough National Estuarine Research Reserve.

DISCLAIMER

ABOUT THE ELKHORN SLOUGH TECHNICAL REPORT SERIES

The mission of the Elkhorn Slough Foundation and the Elkhorn Slough National Estuarine Research Reserve is conservation of estuarine ecosystems and watersheds, with particular emphasis on Elkhorn Slough, a small estuary in central California. Both organizations practice science-based management, and strongly support applied conservation research as a tool for improving coastal decision-making and management. The Elkhorn Slough Technical Report Series is a means for archiving and disseminating data sets, curricula, research findings or other information that would be useful to coastal managers, educators, and researchers, yet are unlikely to be published in the primary literature.

Executive Summary

The following was developed as a final project for ES 2023: Drone Technology and the Environment, summer 2018, taken through Unity College with Sue Bickford as lead professor. This final project is intended as a guide for future drone operators.

This report has been modified in order to be used as a reference for UAS operators for all aspects of using a drone for whatever application they are using. We have added the use of UAS as another tool in our research and monitoring here at ESNERR. We began our drone program in 2015 and have used imagery associated with them for a wide range of projects; quantifying percent cover of invasive species and tracking growth over time, monitoring elevation at a restoration site with centimeter-level accuracy, correlating percent cover of algal mats to water quality parameters, documenting changes after removal of eucalyptus trees, monitoring rare plants and monitoring their annual growths, etc.

In this report we run through a range of applications associated with a drone flight from logging information about the drone itself, to a suggested check list to make sure nothing is forgotten when doing a flight, to how to get certified and obtaining a pilot's license. This is not meant to be an all-inclusive reference report but we do provide lots of other references and resources we have found to be useful over the years of our drone program.

Table of Contents

Section 1: Unoccupied Aircraft System Information

1.1 UAV Model Specification Worksheet

Manufacturer	DJI
Model Name	WM331A Phantom 4 Advanced
Date of Purchase	Jan 2018
Date of first flight	Jan 2018
Serial Number	Xxxx - xxxx
Weight (lbs)	3.01
Registration #	FA3WXXXXXX
Radio Frequency	2.4 GHz
Battery Type	Lithium
Average Battery Life	20 mins
Number of batteries	3
Total number of Cameras	2
Camera Type	RGB
Camera Resolution (mega pixels)	20
Camera Type (Camera 2)	NIR
Camera Resolution (cam 2)	12

This is an example of good information to have about each drone that is purchased. This can be referred to for future use as well as documentation for current inventory on hand.

1.2 UAV Flight Checklist.

The flight checklist is critical for all flights. This is similar to the idea of a flight checklist for occupied aircraft. This allows the pilot in command to ensure preparedness for all aspects of the flight including checking current weather conditions prior to planned flight, ensuring all electronics and batteries are fully charged and SD cards are cleared and installed. This also has checks if any other persons are involved that they are up to speed on all operating, safety, and contingency procedures. There are also final pre-flight checks of local NOTAMS to ensure no local flight restrictions are in place the day of the flight. The final checks are meant for those prior to flight, ensuring aircraft is flight worthy, all propellers are in good condition and secured, cable connections are secure, all storage attachments are removed etc.

This flight checklist is not meant to be exhaustive nor “written in stone”. This is meant at a template from which individuals can add or subtract to tailoring to their specific needs. This checklist was trimmed down from the California State Fish and Wildlife drone program checklist in order to make a one page checklist.

Date/Time of Flight	Pilot in Command
Visual Observer	Location of Flight
Weather Conditions	
Sky:	
Temperature:	
Wind Speed:	* 15 mph Max recommended
Visibility (3mi required):	* 3 Mile Visibility Required

Pre-Flight Checks	**Check**	**All Persons involved in flight are familiar with**	**Check**
Local Weather forecast		Operating conditions	
Check airspace restrictions		Emergency procedures	
All batteries fully charged Drone, RC, tablet		Contingency Procedures	
Control links working properly		Roles and responsibilities	
PIC cert. and Aircraft reg on hand		Potential Hazards	
SD card(s) cleared and installed			
Flight Preparation Checks	**Check**	**Airspace/ Pre-flight Checks**	**Check**
Check cable connections		Check for TFR's/NOTAMS	
Remove camera mount if present		Identify airspace hazards (power lines, trees, birds)	
Check and clean lens			
Check motor mounts, propellers are secure			
RC switch position (P for Phantom)			
Verify "Return to Home" settings			

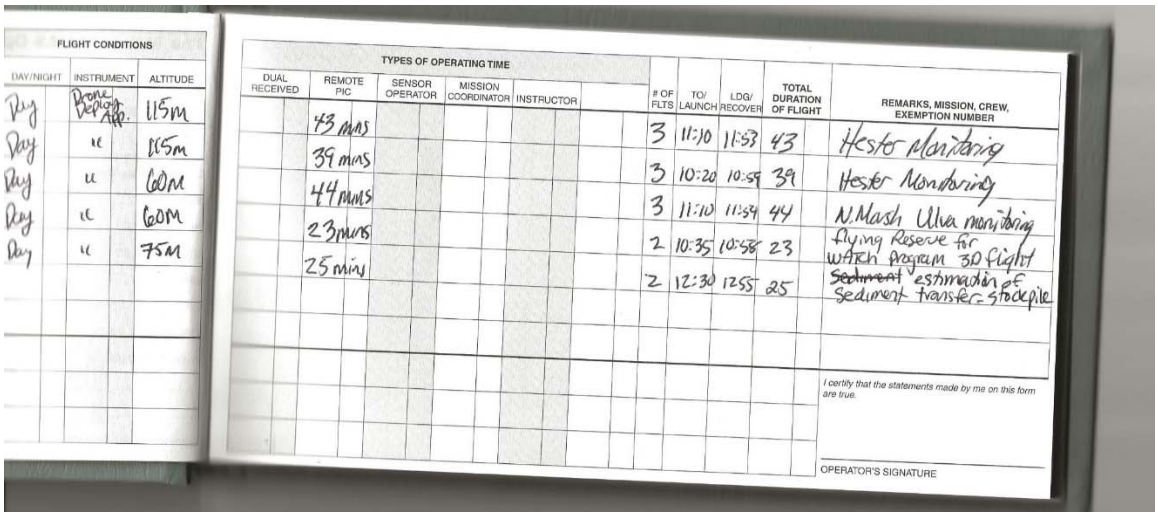
Flight log

1. Altitude:_____ Battery #:_____ Start:_____ End:_____ App:_____
2. Altitude:_____ Battery #:_____ Start:_____ End:_____ App:_____
3. Altitude:_____ Battery #:_____ Start:_____ End:_____ App:_____
4. Altitude:_____ Battery #:_____ Start:_____ End:_____ App:_____
5. Altitude:_____ Battery #:_____ Start:_____ End:_____ App:_____

Notes: Document technical issues, flight issues, App issues, irregularities, etc.

Section 2: Pilot Information/Training Record

2.1 Sample Pilot Log



FLIGHT CONDITIONS			TYPES OF OPERATING TIME									
DAY/NIGHT	INSTRUMENT	ALTITUDE	DUAL RECEIVED	REMOTE PIC	SENSOR OPERATOR	MISSION COORDINATOR	INSTRUCTOR	# OF FLTS	TO/ LAUNCH	LDG/ RECOVER	TOTAL DURATION OF FLIGHT	REMARKS, MISSION, CREW, EXEMPTION NUMBER
Day	Drone Deployment App.	115m		43 mins				3	11:10	11:53	43	Hester Monitoring
Day	"	115m		39 mins				3	10:20	10:59	39	Hester Monitoring
Day	"	60m		44 mins				3	11:10	11:54	44	N. Mash Ulva monitoring
Day	"	60m		23 mins				2	10:35	10:58	23	flying Reserve for WATH program 3D flight
Day	"	75m		25 mins				2	12:30	12:55	25	~~Sediment~~ estimation of Sediment transfer stockpile

I certify that the statements made by me on this form are true.

OPERATOR'S SIGNATURE

2.2 ALC-451: Part 107 small Unoccupied Aircraft Systems

Date of Registration _____

https://www.faasafety.gov/gslac/ALC/course_content.aspx?cID=451&sID=733&crID=1436761

2.3 Integrated Airman Certification and Rating Application (IACRA)

Date of Registration _____

https://iacra.faa.gov/iacra/Default.aspx

2.4 Remote Pilot Knowledge Test (FAA-G-8082-20)

See appendix A

Date of Registration _____

Recurring Training Date _____

Section 3: Site Visit

3.1 Site Evaluation Template;

This template may prove useful when heading to site for the first time and during the evaluation/preparation process in assessing the site in terms of accessibility, proximity to emergency resources and overall environmental and human risk.

Location of site:	**Landowner Point of Contact/phone #:**
Flight day point of contact/phone #	**Expected Weather:**
Directions from Major Highway:	
Name and Distance from Nearest Airport:	
Name of Nearest Hospital/Directions:	
County Sheriff or City Police phone number:	
Airspace Hazards:	
Hazards Identification:	
PAVE checklist:	
Potential Wildlife Risks:	
Human impact:	

3.2 Site Evaluation Sample

Location of site: Elkhorn Slough Hester Marsh	**Landowner Point of Contact/phone #:** Sue Bickford 831-777-5555
Flight day point of contact/phone # Sue Bickford 831-777-5555	**Expected Weather:** High potential for fog and winds check for current weather.
Directions from Major Highway: From HWY 1 drive east on Dolan road. Take Via Tanques North about 1.5 miles east of HWY 1. Drive to end of road to find access to location of takeoff area.	
Name and Distance from Nearest Airport: Watsonville Municipal Airport. 6.2 miles	
Name of Nearest Hospital/Directions: Watsonville Hospital Drive North on 8.2 miles HWY 1 to Airport Blvd. Hospital is on South side 0.2 miles east from exit ramp.	
County Sheriff or City Police phone number: 831-755-5100	
Airspace Hazards: Outside airport and Hospital airspace zones	
Hazards Identification: Winds usually pick up in afternoon from the NW could be up to 15 MPH. Some trees on uplands from site. Airport nearby so watch for aircraft.	
PAVE checklist: See map for hazards identified.	
Potential Wildlife Risks: Marine Mammals in area – Harbor Seal and California Sea Otters Seabirds and Birds of Prey frequent the area. No known nests in area	
Human impact: Junk yard nearby, be sure flight path does not intersect airspace above their location.	

Resources:

Google Earth	https://www.google.com/earth/
Air Map App.	https://app.airmap.io/
Weather Underground	https://www.wundergrougd.com/

3.3 Risk Assessment Template

Severity of Consequences			Likelihood of occurrence		
Severtiy Level	**Description**	**Score**	**Likelihood level**	**Description**	**Score**
Catastrophic		A	Frequent		5
Severe		B	Occasional		4
Major		C	Remote		3
Minor		D	Most unlikely		2
Negligible		E	Extremely unlikely		1

3.4 Risk Assessment Sample

Severity of Consequences			Likelihood of occurrence		
Severity Level	**Description**	**Score**	**Likelihood level**	**Description**	**Score**
Catastrophic	Equipment destroyed, one to multiple deaths, opportunity extremely unlikely to happen again	A	Frequent	greater 95% chance to loose aircraft, crash into a tree, junk yard, water, marsh or other manned aircraft	5
Severe	Major equipment damage, injuries require hospitalization, severely reduced safety margins, opportunity unlikely to happen again	B	Occasional	greater than 75% chance to occur	4
Major	Major malfunction in equipment but still operable, injuries to persons, opportunity may or may not happen again	C	Remote	30% chance to occur	3
Minor	Limited equipment functionality, minor injury not requiring more than a band aid, opportunity most likely to happen again	D	Most unlikely	5% chance to occur	2
Negligible	Little to no consequence, almost certain to get the opportunity next time	E	Extremely unlikely	Hard to conceive would ever occur	1

Risk Likelihood		Risk Severity				
		Catastrophic A	Severe B	Major C	Minor D	Negligible E
Frequent	5	5 A	5 B	5 C	5 D	5 E
Occasional	4	4 A	4 B	4 C	4 D	4 E
Remote	3	3 A	3 B	3 C	3 D	3 E
Most Unlikely	2	2 A	2 B	2 C	2 D	2 E
Extremely Unlikely	1	1 A	1 B	1 C	1 D	1 E

Section 4: Mission Planning

4.1 Mission Plan Template

Location of Site:	**Landowner point Contact/phone number:**
Flight Day Point of Contact:	**Expected weather:**
Directions from Major Highway:	
Name and distance from nearest airport:	
Name of nearest Hospital/Directions:	
County Sheriff or City Police phone number:	
Airspace Hazards:	
Hazards Identification:	
Privacy Considerations:	
Take off site	**Landing Site:**
Primary: **Secondary:**	**Primary:** **Secondary:**

SWOT model for DJI Phantom 4

Strengths	Weakness
•	•
Opportunities	**Threats**
•	•

4.2 Mission Plan Sample

SWOT model for DJI Phantom 4

Strengths	Weakness
• Easy to fly • Hover capabilities for stable photos • Good endurance 18 min flight times	• Limited distance coverage • Only RGB photographs •
Opportunities	**Threats**
• Provide a unique perspective to others • Creativity from seeing this new perspective • Other sensors could be mounted on this aircraft, 3D cameras, NIR camera	• Unclear regulations • Privacy concerns • Potential for wildlife disturbances

Location of site: Elkhorn Slough Hester Marsh	**Landowner Point of Contact/phone #:** Sue Bickford 831-777-5555
Flight day point of contact/phone # Sue Bickford 831-777-5555	**Expected Weather:** High potential for fog and winds check for current weather.
Directions from Major Highway: From HWY 1 drive east on Dolan road. Take Via Tanques North about 1.5 miles east of HWY 1. Drive to end of road to find access to location of takeoff area.	
Name and Distance from Nearest Airport: Watsonville Municipal Airport. 6.2 miles	
Name of Nearest Hospital/Directions: Watsonville Hospital Drive North on 8.2 miles HWY 1 to Airport Blvd. Hospital is on South side 0.2 miles east from exit ramp.	
County Sheriff or City Police phone number: 831-755-5100	
Airspace Hazards: Outside airport and Hospital airspace zones	
Hazards Identification: Winds usually pick up in afternoon from the NW could be up to 15 MPH. Some trees on uplands from site. Airport nearby so watch for aircraft.	

PAVE checklist: See map for hazards identified.
Potential Wildlife Risks: Marine Mammals in area – Harbor Seal and California Sea Otters Seabirds and Birds of Prey frequent the area. No known nests in area
Human impact: Junk yard nearby, be sure flight path does not intersect airspace above their location.

4.3 Mission Plan: California Sea Otter Considerations

Conditions for Flight Activities over Sea Otters		
Activity	**Altitude**	**Conditions**
Fixed-wing plane overflights	Above 183 m (600 ft) ASL	No conditions
	Between 61 m (200 ft) and 183 m (600 ft) ASL	No intentional repeated passes or circling over sea otters
	Below 61 m (200 ft) ASL	Not permitted
Helicopter overflights	Above 305 m (1000 ft) ASL	No conditions
	Between 152 m (500 ft) and 305 m (1000 ft) ASL	No hovering within 200 m (656 ft) horizontal distance of sea otters; monitor required*
	Below 152 m (500 ft)	Not permitted
Drone (all types)	Above 60 m (197 ft) ASL	No conditions
	Between 20 m (66 ft) and 60 m (197 ft) ASL	Monitor required*
	Below 20 m (66 ft)	Not permitted

*Conditions were developed by CDFW and USFWS on 11/25/19. Ground-based or boat-based biological monitor(s) are required to monitor overflight activities to obtain information on sea otter responses and to ensure that disturbance does not occur. Disturbance is defined as causing one or more resting sea otters to dive or causing an active sea otter to flee. If the monitor determines that an animal has been or will imminently be disturbed, all overflight activity must cease in that location. One biological monitor is capable of monitoring no more than a 1-km radius at one time; if a larger area will be overflown, multiple monitors will be required to cover the potential area of impact. Qualifications of monitors will be approved by MBNMS based on experience observing sea otters using binoculars and spotting scopes/telescopes and ability to recognize sea otter behaviors. Monitoring reports shall be submitted within 30 days of completion of an activity and shall provide the following information: type of vehicle flown; activity of vehicle (direct pass or hovering); approach distances to sea otters (both horizontal and vertical); sea otter reactions (turning head, sculling while remaining dry, diving, surface-swimming) to each approach; duration of activity; environmental conditions (cloud cover, wind speed and direction, temperature, tide height); and observer location(s) relative to the observed sea otters.

4.4 List of Resources

UAViators	http://uaviators.org/
Precision Hawk	https://www.precisionhawk.com/
B4UFly app	https://www.faa.gov/uas/recreational_fliers/where_can_i_fly/b4ufly/ Great app from FAA to identify airspace and any current advisories in area you wish to fly
Drone seed	www.droneseed.com
The Drone Girl	thedronegirl.com
Advisory Circular	https://www.faa.gov/uas/media/AC_107-2_AFS-1_Signed.pdf - Advisory Circular with all info needed from FAA
Drone Life	dronelife.com
Mark Bathrik (DOI)	https://www.doi.gov/aviation/uas - Department of interiors Mark Bathriks presentation on **"How to Develop and Sustain a Successful Unmanned Aircraft Systems (UAS) Program for Enhanced Science, Safety, and Savings - USGS Workshop"**

www.auvsi.org/code-conduct

The FAA Remote Pilot exam is given at FAA certified Knowledge Testing Centers (KTC), usually found at airports. The cost is approximately $150. This site has the number to call to make a reservation, and the list of where the testing centers are: https://faa.psiexams.com/faa/login

You can also find the list of testing centers directly on the FAA site here:
https://www.faa.gov/uas/getting_started/fly_for_work_business/becoming_a_pilot/

There are a number of study guides and courses out there, but we've found the following to be useful:

A. The Remote Pilot Knowledge Test Prep section of the FAA "Becoming a Pilot" page:
https://www.faa.gov/uas/getting_started/fly_for_work_business/becoming_a_pilot/

The FAA has published a Knowledge Test Study Guide:

https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/media/remote_pilot_study_guide.pdf

As well as a number of other helpful documents.

B. The following materials are very useful to have:

-Remote Pilot Test Prep (~$15)

This book provides a review of the 5 topic areas on the test, with sample questions and answer explanations. Additional, it provides a code that gives you 5 online practice tests through PrepWare.

https://www.amazon.com/Remote-Pilot-Test-Prep-2020/dp/1619547961/ref=pd_sbs_14_1/130-6692127-1164136?_encoding=UTF8&pd_rd_i=1619547961&pd_rd_r=8e2d63bf-d39c-4751-ae3b-181abeb8fa4e&pd_rd_w=TjCHm&pd_rd_wg=cp5J7&pf_rd_p=52ff3488-8ecd-4341-9663-52e4fb00f500&pf_rd_r=B5WKVKF7WGN82MKSP67Y&psc=1&refRID=B5WKVKF7WGN82MKSP67Y

-Airman Knowledge Testing Supplement (~$10)

This is the book of figures that will be referenced on the actual test. It will be provided to you at the testing location for your use during the test, but it helps to become familiar with what's in this book prior to the test, as it's the only reference book you're allowed to have during the test.

https://www.amazon.com/FAA-COMPUTER-TESTING-SUPPLEMENTS-RECREATIONAL/dp/B01I5PCXV0/ref=lp_8937642011_1_2?srs=8937642011&ie=UTF8&qid=1484346152&sr=8-2

-FAA Sectional Chart (~$10)

Learning to read Sectionals is key to passing the test, and it helps to have a full chart on hand. Also, it helps to become familiar with your local airspace and the places you'll be flying. For California, there are 4 possible Sectionals: Klamath Falls, San Francisco, Los Angeles, and Las Vegas.

https://www.amazon.com/FAA-Charts/b/ref=bl_dp_s_web_16041552011?ie=UTF8&node=16041552011&field-lbr_brands_browse-bin=FAA+Charts

-PrepWare Remote Pilot app ($5)

This mobile app provides a large set of test questions and a variety of ways to go through them, including sample timed 60 questions exams, like what the actual test entails.

C. Pilot Training System free online tutorial videos here:
https://www.youtube.com/channel/UC99vrs8wqlfx3WU6I967fqA

We have downloaded them locally to the O: drive, here:

O:\POLICY-ISSUES\Drones\TrainingInfo

Appendix:

Appendix A: Remote Pilot Knowledge Test (FAA-G-8082-20)

FAA-G-8082-20

Remote Pilot Knowledge Test Guide

February 2017

U.S. Department of Transportation
Federal Aviation Administration

INTRODUCTION

FAA-G-8082-20, Remote Pilot Knowledge Test Guide, dated February 2017, provides information for preparing you to take the following airman knowledge test (AKT).

Test Name	Test Code
Unmanned Aircraft General – Small	UAG

Federal Aviation Administration (FAA) airman knowledge tests are effective instruments for aviation safety and regulation compliance measurement. However, these tests can only sample the vast amount of knowledge every pilot needs to operate safely in the National Airspace System (NAS).

Comments may be emailed to AFS630Comments@faa.gov.

KNOWLEDGE TEST ELIGIBILITY REQUIREMENTS

For a summary of knowledge test eligibility requirements for the certification area listed above, refer to the FAA Airman Knowledge Testing Authorization Matrix located at http://www.faa.gov/training_testing/testing/media/testing_matrix.pdf

The general qualifications for a Remote Pilot Certificate require that you have the appropriate knowledge to operate safely in the National Airspace System (NAS).

ENGLISH LANGUAGE PROFICIENCY

In accordance with the requirements of AC 107-2, Small Unmanned Aircraft Systems (sUAS), and the aviation English Language proficiency requirements, you must accomplish the entire application process and testing procedures with sufficient fluency in the English language so that crew coordination and communication is never in doubt. Normal restatement of questions, as would be done for an applicant who is a native English speaker, is permitted and should not be deemed grounds for disqualification.

Title 14 of the Code of Federal Regulations (14 CFR) part 107, Small Unmanned Aircraft Systems, requires that pilots must be able to read, write, speak, and understand the English language. If you cannot meet these requirements of English fluency, an airman certificate cannot be issued.

If you are pursuing a Remote Pilot Certificate you should carefully review the appropriate sections of 14 CFR part 107.73 for detailed information pertaining to this subject.

KNOWLEDGE AREAS ON THE TESTS

The Unmanned Aircraft General – Small airman knowledge test covers the following knowledge areas:

(1) Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation;

(2) Airspace classification, operating requirements, and flight restrictions affecting small unmanned aircraft operation;

(3) Aviation weather sources and effects of weather on small unmanned aircraft performance;

(4) Small unmanned aircraft loading;

(5) Emergency procedures;

(6) Crew resource management;

(7) Radio communication procedures;

(8) Determining the performance of small unmanned aircraft;

(9) Physiological effects of drugs and alcohol;

(10) Aeronautical decision-making and judgment;

(11) Airport operations; and

(12) Maintenance and preflight inspection procedures.

DESCRIPTION OF THE TEST

All test questions are objective and multiple-choice. Each question can be answered by the selection of a single response. Each test question is independent of other questions; therefore, a correct response to one does not depend upon, or influence, the correct response to another. **The minimum passing score is 70 percent.** The UAG test contains 60 questions; you are allowed 2 hours to complete.

APPLYING FOR A REMOTE PILOT CERTIFICATE WITH A SMALL UAS RATING

When applying for a Remote Pilot Certificate with a Small UAS rating, the applicant must meet one of the following:

- An applicant who chooses to take the knowledge test for an sUAS rating must successfully pass the knowledge test, and make an application via the Integrated Airman Certification and Rating Applicant (IACRA) web site. IACRA may be found at this URL: https://iacra.faa.gov/IACRA/Default.aspx.

- If the person holds a pilot certificate issued under 14 CFR part 61 and meets the recency requirements specified in § 61.56, the applicant must provide a certificate of completion of an initial training course The applicant must also show via logbook entry or other method acceptable to the Administrator that they meet the flight review requirements of § 61.56.

- Additionally, the applicant must meet the requirements of §107.61.

An applicant who meets the requirements of holding a 14 CFR part 61 pilot certificate, meets the recency of experience requirements (14 CFR 61.56), and has successfully completed the online training course, must submit their application to a Flight Standards District Office (FSDO), a Designated Pilot Examiner (DPE), an Airman Certification Representative (ACR) for a pilot school, a certified flight instructor, or other person authorized by the Administrator to process the application.

An applicant will find the application requirements in AC 107-2, Small Unmanned Aircraft Systems (sUAS), at https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_107-2.pdf.

TEST REGISTRATION

The FAA has designated two Airman Knowledge Testing (AKT) Organization Designation Authorization (ODA) Holders, which sponsor hundreds of knowledge testing center locations. These testing centers offer a full range of airman knowledge tests including: Unmanned Aircraft Systems (UAS), Aircraft Dispatcher, Airline Transport Pilot, Aviation Maintenance Technician, Commercial Pilot, Flight Engineer, Flight Instructor, Flight Navigator, Ground Instructor, Inspection Authorization, Instrument Rating, Parachute Rigger, Private Pilot, Recreational Pilot, Sport Pilot and Military Competence. Contact information for the AKT ODA Holders is provided below under Knowledge Test Centers.

The first step in taking a knowledge test is the registration process. You may either call a central registration phone number or appear at a testing center on a walk-in basis. If you choose to use a central registration phone number to schedule your test, you will need to be prepared to select a test date, choose a testing center, and make financial arrangements for test payment. You may register for tests several weeks in advance, and you may cancel your appointment according to the AKT ODA Holder's cancellation policy. If you do not follow the AKT ODA Holder's cancellation policies, you could be subject to a cancellation fee.

APPLICANT IDENTIFICATION AND TEST AUTHORIZATION

The next step in taking a knowledge test is providing proper identification. You should determine what knowledge test prerequisites are necessary before going to the computer-testing center. Your local FAA Flight Standards District Office (FSDO) may advise you regarding the documentation required to be presented at the testing facility. Testing center personnel will not begin the test until your identification and eligibility is verified.

Acceptable forms of authorization and retesting procedures are available in the latest version of the Applicant Identification, Information, Verification, & Authorization Requirements Matrix located at: http://www.faa.gov/training_testing/testing/media/testing_matrix.pdf.

TEST TAKING TIPS

Prior to launching the actual test, the AKT ODA Holder's testing software will provide you with an opportunity to practice navigating through the test. This practice (or tutorial) session may include a "sample" question(s). These sample questions have no relation to the content of the test, but are meant to familiarize you with the look and feel of the system screens, including selecting an answer, marking a question for later review, time remaining for the test, and other features of the testing software.

When taking a test, keep the following points in mind:

- Carefully read the instructions given with the test.
- Answer each question in accordance with the latest regulations and guidance publications.
- Read each question carefully before looking at the answer options. You should clearly understand the problem before attempting to solve it.
- After formulating an answer, determine which answer option corresponds with your answer. The answer you choose should completely resolve the problem.
- From the options given, it may appear there is more than one possible answer; however, there is only one answer that is correct and complete. The other options are either incomplete, erroneous, or derived from popular misconceptions.
- If a certain question is difficult for you, it is best to mark it for review and proceed to the next question. After you answer the less difficult questions, return to those marked for review and

answer them. The review marking procedure will be explained to you prior to starting the test. Although the computer should alert you to unanswered questions, make sure every question has an answer recorded. This procedure will enable you to use the available time to maximum advantage.

- When solving a calculation problem, select the answer closest to your solution. The problem has been checked with various types of calculators; therefore, if you have solved it correctly, your answer will be closer to the correct answer than any of the other choices.
- For graph type questions, you may request a printed copy of the graph upon which you may actually draw and write to compute the answer. All paper work must be turned in to the test center representative upon completion of the test.

USE OF TEST AIDS AND MATERIALS

You may use aids, reference materials, and test materials within the guidelines listed below, if actual test questions or answers are not revealed. All models of aviation-oriented calculators may be used, including small electronic calculators that perform only arithmetic functions (add, subtract, multiply, and divide). Simple programmable memories, which allow addition to, subtraction from, or retrieval of one number from the memory, are permissible. Also, simple functions, such as square root and percent keys are permissible.

The following guidelines apply:

1. You may use any reference materials provided with the test. In addition, you may use scales, straightedges, protractors, plotters, navigation computers, log sheets, and electronic or mechanical calculators that are directly related to the test.
2. Manufacturer's permanently inscribed instructions on the front and back of such aids (e.g., formulas, conversions, regulations, signals, weather data, frequencies, weight-and-balance formulas) are permissible.
3. Testing centers may provide a calculator to you and/or deny use of your personal calculator based on the following limitations:
    a. Prior to, and upon completion of the test, while in the presence of the Unit Member (formerly referred to as proctor), you must actuate the ON/OFF switch and perform any other function that ensures erasure of any data stored in memory circuits.
    b. The use of electronic calculators incorporating permanent or continuous type memory circuits without erasure capability is prohibited. The Unit Member may refuse the use of your calculator when unable to determine the calculator's erasure capability.
    c. Printouts of data must be surrendered at the completion of the test if the calculator incorporates this design feature.
    d. The use of magnetic cards, magnetic tapes, modules, computer chips, or any other device upon which pre-written programs or information related to the test can be stored and retrieved is prohibited.
    e. You are not permitted to use any booklet or manual containing instructions related to use of test aids.
4. Dictionaries are not allowed in the testing area.
5. The Unit Member makes the final determination relating to test materials and personal possessions you may take into the testing area.

TESTING PROCEDURES FOR APPLICANTS REQUESTING SPECIAL ACCOMMODATIONS

If you are an applicant with a learning or reading disability, you may request approval from AFS-630, through the local FSDO or IFO, to take an airman knowledge test using one of the three options listed below, in preferential order:

Option 1. Use current testing facilities and procedures whenever possible.

Option 2. You may use a self-contained, electronic device which pronounces and displays typed-in words (e.g., the Franklin Speaking Wordmaster®) to facilitate the testing process. (NOTE: The device should consist of an electronic thesaurus that audibly pronounces typed-in words and presents them on a display screen. The device should also have a built-in headphone jack for private listening in order to avoid disturbing others during testing.)

Option 3. If you do not choose to use the first or second option, you may request Unit Member assistance in reading specific words or terms from the test questions and/or supplement book. In the interest of preventing compromise of the testing process, the Unit Member must be an individual with no aviation background or expertise. The Unit Member must provide reading assistance only, with no explanation of words or terms. When this option is requested, the FSDO or IFO inspector must contact the Airman Testing Standards Branch (AFS-630) for assistance in selecting the test site and assisting Unit Member.

Prior to approval of any option, the FSDO or IFO Aviation Safety Inspector must advise you of the regulatory certification requirement of being able to read, write, speak, and understand the English language.

CHEATING OR OTHER UNAUTHORIZED CONDUCT

Computer testing centers must follow strict security procedures to avoid test compromise. These procedures are established by the FAA and are covered in FAA Order 8080.6 (as amended), Conduct of Airman Knowledge Tests. The FAA has directed testing centers to terminate a test at any time a test Unit Member suspects a cheating incident has occurred. An FAA investigation will then be conducted. If the investigation determines that cheating or unauthorized conduct has occurred, any airman certificate or rating you hold may be revoked, and you will be prohibited for 1 year from applying for or taking any test for a certificate or rating under 14 CFR part 107 or 14 CFR part 61.

LEARNING STATEMENTS

Learning statements, as used in airman knowledge testing, refer to a measurable level of knowledge a student should be able to demonstrate as outlined in the appropriate Airman Certification Standards (ACS). The most current Learning Statement Reference Guide for Airman Knowledge Testing is online at http://www.faa.gov/training_testing/testing/media/LearningStatementReferenceGuide.pdf.

We provide learning statements to help an applicant become more familiar with the areas of knowledge applicable to the airman training, learning, studying, and testing processes.

Beyond serving as a useful reference in preparing for your airman knowledge test, the Learning Statement Reference Guide will assist you in interpreting any learning statement codes that may appear on your Airman Knowledge Test Report. You will receive a test report immediately upon completion of the test. This report will list learning statement codes for any questions you may have answered incorrectly. You should match the codes on the test report to the information in the Learning Statement Reference Guide in order to obtain the corresponding areas of knowledge deficiency.

AIRMAN KNOWLEDGE TEST REPORTS

Upon completion of the knowledge test, you will receive your Airman Knowledge Test Report, which reflects your score. The test report will be stamped with the testing center's raised/embossed seal.

Should you require a duplicate Airman Knowledge Test Report due to loss or destruction of the original, send a signed request accompanied by a check or money order for $12.00, payable to the FAA. Send the request to:

Federal Aviation Administration
Airmen Certification Branch, AFS-760
P.O. Box 25082
Oklahoma City, OK 73125

Airman Knowledge Test Reports are valid until the end of the month 24-calendar months after completing the knowledge test. **If the Airman Knowledge Test Report expires before you complete the application process, you must retake the knowledge test.**

REQUESTING A HAND-SCORE

If you wish to have your test hand-scored, you must submit a request, in the form of a signed letter, to the Airman Testing Standards Branch, AFS-630. The request must be accompanied by a copy of your Airman Knowledge Test Report and a legible photocopy of a government issued identification with your photograph and signature. Mail or fax this information to: (email requests are not accepted due to security issues.)

Federal Aviation Administration
Airman Testing Standards Branch, AFS-630
P.O. Box 25082
Oklahoma City, OK 73125
Or Fax to: 405 954-4748

Note: If you have comments regarding test questions, test procedures, or supplemental material content, please email AFS-630 at: AFS630Comments@faa.gov.

TRAINING AND TESTING PUBLICATIONS AND GENERAL INFORMATION

Most of the current Flight Standards Service airman training and testing publications can be obtained in electronic format from the FAA Website, www.faa.gov. The training and testing publications and general information can be found on the opening page of that Website under the Training and Testing tab. If a publication is not available in electronic format, there are instructions for obtaining paper copies. Information found on the Website includes the following:

- Advisory Circulars
- Airworthiness Directives
- Code of Federal Regulations
- Computer Testing Supplements
- Knowledge Test Centers
- Sample Knowledge Test questions
- Knowledge Test Statistics

- Learning Statement Reference Guide
- Type Certificate Data Sheets

Advisory Circulars

Advisory circulars (ACs) provide guidance and information on various subjects related to airman certification.

Airworthiness Directives

Airworthiness Directives (ADs) are notifications to aircraft owners of a known safety deficiency with a specific model of aircraft, engine, avionics, or other system.

Code of Federal Regulations

The portion of 14 CFR containing what was formerly known as the Federal Aviation Regulations can be found on the Website. 14 CFR contains regulations designed to promote aviation safety and govern all aviation activities in the United States.

Computer Testing Supplements

The knowledge testing supplements contain the graphics, legends, and maps that are needed to successfully respond to certain knowledge test items. ODA test center personnel will provide these supplements during the airman knowledge test. You can review them prior to testing at: http://www.faa.gov/training_testing/testing/supplements/media/sport_rec_private_akts.pdf. Marking in the supplement book is prohibited; however, you may request a photo copy of any figure either before or during your exam. This marked or unmarked copy must be returned to the proctor at the end of the exam.

Note: *The Unmanned Aircraft - General test currently uses FAA-CT-8080-2G, Airman Knowledge Testing Supplement for Sport Pilot, Recreational Pilot, and Private Pilot. You may review it prior to taking the exam.*

Knowledge Test Centers

The Knowledge Test Centers portion of the Website contains current listings of Airman Knowledge Testing (AKT) Organization Designation Authorization (ODA) Holders and other testing centers, and the registration telephone numbers to call to register for a test.

The following is a list of the ODA holders authorized to give FAA airman knowledge tests. This list should be helpful in case you choose to register for a test or simply want more information.

- **Computer Assisted Testing Service (CATS)**
  777 Mariners Island Blvd., Suite 200
  San Mateo, CA 94404
  Applicant inquiry and test registration: 1-800-947-4228
  From outside the U.S. (650) 259-8550

- **PSI**

  16821 SE McGillivray Blvd., Suite 201
  Vancouver, WA 98683
  Applicant inquiry and test registration: 1-800-211-2753 or 1-800-211-2754
  From outside the U.S. (360) 896-9111

Knowledge Test Questions

Sample questions are located in the Airman Knowledge Test Questions section of the Website and represent the types of questions included in the actual test banks. Practicing these questions will help you become familiar with similar questions on the airman knowledge tests. The knowledge test is not designed to intimidate any prospective airman; it is designed to measure an applicant's understanding of the rules, regulations and knowledge areas required to receive an sUAS rating.

Knowledge Test Statistics

Test statistics for most airman knowledge tests are contained in a series of tables organized by year and subject area. Individual tables are provided for the following subject areas: test volume, pass rates, average test scores, countries, regions, and district offices.

Classification Code

Topic, Content and Specific (TCS) codes listed in this guide are NOT a description of the Learning Statement Codes (LSC) found in the 'Learning Statement Reference Guide for Airman Knowledge Testing' document, but are a hierarchical sequence of classification codes placing a question in a unique category. FAA knowledge test question development uses the following hierarchy:

- Topic— Overall subject matter topic code. The highest classification of overall subject matter a knowledge test item was developed to assess (e.g., Aerodynamics).
- Content—Secondary level subject matter code (e.g., Airspeed).
- Specific— the basic hierarchical classification code the subject matter for a knowledge test item (e.g., Thrust).

References
Appendix

The Unmanned Aircraft General – Small knowledge test is based on the following 14 CFR parts, FAA guidance documents, manufacturer's publications, and other documents.

Reference	Title
14 CFR part 47	Aircraft Registration
14 CFR part 48	Registration and Marking Requirements for Small Unmanned Aircraft Systems
14 CFR part 71	Designation of Class A, B, C, D and E Airspace Areas; Air Traffic Service Rotes; and Reporting Points
14 CFR part 107	Operation and Certification of Small Unmanned Aircraft Systems
AC 00-6	Aviation Weather
AC 150/5200-32	Reporting Wildlife Aircraft Strikes
AC 107-2	Small Unmanned Aircraft Systems (sUAS)
AIM	Aeronautical Information Manual
FAA-H-8083-2	Risk Management Handbook
FAA-H-8083-25	Pilot's Handbook of Aeronautical Knowledge
SAFO 09013	Fighting Fires Caused By Lithium Type Batteries in Portable Electronic Devices
SAFO 10015	Flying in the wire environment
SAFO 10017	Risks in Transporting Lithium Batteries in Cargo by Aircraft
SAFO 15010	Carriage of Spare Lithium Batteries in Carry-on and Checked Baggage

Note: *Users should reference the current edition of the reference documents listed above. Safety Alerts for Operators (SAFOs) and the current edition of all FAA publications can be found at www.faa.gov.*

Appendix B: Fact Sheet Part 107

Fact Sheet – Small Unmanned Aircraft Regulations (Part 107)
For Immediate Release

June 21, 2016
Contact: Les Dorr or Alison Duquette
Phone: 202-267-3883

The new rules for non-hobbyist small unmanned aircraft (UAS) operations – Part 107 of the Federal Aviation Regulations (PDF) – cover a broad spectrum of commercial uses for drones weighing less than 55 pounds. Here are the highlights of the new rule.

Operating Requirements
The small UAS operator manipulating the controls of a drone should always avoid manned aircraft and never operate in a careless or reckless manner. You must keep your drone within sight. Alternatively, if you use First Person View or similar technology, you must have a visual observer always keep your aircraft within unaided sight (for example, no binoculars). However, even if you use a visual observer, you must still keep your unmanned aircraft close enough to be able to see it if something unexpected happens. Neither you nor a visual observer can be responsible for more than one unmanned aircraft operation at a time.

You can fly during daylight or in twilight (30 minutes before official sunrise to 30 minutes after official sunset, local time) with appropriate anti-collision lighting. Minimum weather visibility is three miles from your control station. The maximum allowable altitude is 400 feet above the ground, and higher if your drone remains within 400 feet of a structure. The maximum speed is 100 mph (87 knots).

You can't fly a small UAS over anyone who is not directly participating in the operation, not under a covered structure, or not inside a covered stationary vehicle. No operations from a moving vehicle are allowed unless you are flying over a sparsely populated area.

Operations in Class G airspace are allowed without air traffic control permission. Operations in Class B, C, D and E airspace need ATC approval. See Chapter 14 in the Pilot's Handbook (PDF).

You can carry an external load if it is securely attached and does not adversely affect the flight characteristics or controllability of the aircraft. You also may transport property for compensation or hire within state boundaries provided the drone – including its attached systems, payload and cargo – weighs less than 55 pounds total and you obey the other flight rules. (Some exceptions apply to Hawaii and the District of Columbia. These are spelled out in Part 107.)

You can request a waiver of most operational restrictions if you can show that your proposed operation can be conducted safely under a waiver. The FAA will make an online portal available to apply for such waivers.

Pilot Certification
To operate the controls of a small UAS under Part 107, you need a remote pilot airman certificate with a small UAS rating, or be under the direct supervision of a person who holds such a certificate

You must be at least 16 years old to qualify for a remote pilot certificate, and you can obtain it in one of two ways:

- You may pass an initial aeronautical knowledge test at an FAA-approved knowledge testing center.
- If you already have a Part 61 pilot certificate, other than a student pilot certificate, you must have completed a flight review in the previous 24 months and you must take a small UAS online training course provided by the FAA.

If you have a non-student pilot Part 61 certificate, you will immediately receive a temporary remote pilot certificate when you apply for a permanent certificate. Other applicants will obtain a temporary remote pilot certificate upon successful completion of a security background check. We anticipate we will be able to issue temporary certificates within 10 business days after receiving a completed application.

UAS Certification
You are responsible for ensuring a drone is safe before flying, but the FAA does not require small UAS to comply with current agency airworthiness standards or obtain aircraft certification.Instead, the remote pilot will simply have to perform a preflight visual and operational check of the small UAS to ensure that safety-pertinent systems are functioning properly. This includes checking the communications link between the control station and the UAS. The UAS must also be registered.

Respecting Privacy
Although the new rule does not specifically deal with privacy issues in the use of drones, and the FAA does not regulate how UAS gather data on people or property, the FAA is acting to address privacy considerations in this area. The FAA strongly encourages all UAS pilots to check local and state laws before gathering information through remote sensing technology or photography.

As part of a privacy education campaign, the agency will provide all drone users with recommended privacy guidelines as part of the UAS registration process and through the FAA's B4UFly mobile app. The FAA also will educate all commercial drone pilots on privacy during their pilot certification process; and will issue new guidance to local and state governments on drone privacy issues. The FAA's effort builds on the privacy "best practices" (PDF) the National Telecommunications and Information Administration published last month as the result of a year-long outreach initiative with privacy advocates and industry.

Other Requirements
If you are acting as pilot in command, you have to comply with several other provisions of the rule:

- You must make your drone available to the FAA for inspection or testing on request, and you must provide any associated records required to be kept under the rule.
- You must report to the FAA within 10 days any operation that results in serious injury, loss of consciousness, or property damage (to property other than the UAS) of at least $500.

References:

U.S. Department of Transportation Federal Aviation Administration, Feb 2017. Remote Pilot Knowledge Test Guide. https://www.faa.gov/training_testing/testing/test_guides/media/remote_pilot_ktg.pdf

U.S. Department of Transportation Federal Aviation Administration, June 2016. Advisory Circular. https://www.faa.gov/uas/media/AC_107-2_AFS-1_Signed.pdf

U.S. Department of Transportation Federal Aviation Administration, March 2018. Fact Sheet Small Unmanned Aircraft Regulations (Part 107). https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=22615