U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: Small Unmanned Aircraft Systems (sUAS)

Date: 6/21/16 **AC No:** 107-2

Initiated by: AFS-800 **Change:**

The Federal Aviation Administration (FAA) is amending its regulations to adopt specific rules for the operation of small Unmanned Aircraft Systems (sUAS) in the National Airspace System (NAS) through a final rule. These changes address the classification of sUAS, certification of sUAS remote pilots, and sUAS operational limitations. This advisory circular (AC) provides guidance for conducting sUAS operations in the NAS in accordance with Title 14 of the Code of Federal Regulations (14 CFR) part 107.

/s/

John S. Duncan
Director, Flight Standards Service

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CHAPTER 1. GENERAL

1.1 Purpose. This advisory circular (AC) provides guidance in the areas of airman (remote pilot) certification, aircraft registration and marking, aircraft airworthiness, and the operation of small Unmanned Aircraft Systems (sUAS) in the National Airspace System (NAS) to promote compliance with the requirements of Title 14 of the Code of Federal Regulations (14 CFR) part 107, Small Unmanned Aircraft Systems. It does not provide, nor is it intended to provide, a legal interpretation of the regulations. Remote pilots are encouraged to use this information as best practice methods for developing operational programs scaled to specific small unmanned aircraft (UA), associated system equipment, and operations. Use of this AC is intended to assist the remote pilot in meeting the requirements of applicable 14 CFR regulations.

1.1.1 Acceptable Means of Compliance (AMC). This AC uses mandatory terms, such as "must," only in the sense of ensuring applicability of these particular methods of compliance when using the AMC described herein. This AC is not mandatory and does not constitute a regulation. This AC does not change, add to, or delete regulatory requirements or authorize deviations from regulatory requirements.

1.1.2 Part 107 Provisions. This AC is not intended to cover every provision of part 107. Rather, this AC is intended to provide guidance on those provisions of part 107 where additional information may be helpful. The Federal Aviation Administration (FAA) emphasizes, however, that persons subject to part 107 are responsible for complying with every applicable provision of part 107, regardless of whether the provision is discussed in this AC.

1.1.3 Privacy-Related Laws. Part 107 operators should be aware that state and local authorities may enact privacy-related laws specific to Unmanned Aircraft System (UAS) operations. The FAA encourages sUAS operators to review those laws prior to operating their UAS. The National Telecommunications and Information Administration (NTIA) has also published the Voluntary Best Practices for UAS Privacy, Transparency, and Accountability (https://www.ntia.doc.gov/files/ntia/publications/voluntary_best_practices_for_uas_privacy_transparency_and_accountability_0.pdf). This document outlines and describes voluntary best practices that UAS operators could take to advance UAS privacy, transparency, and accountability for the private and commercial use of UAS.

1.2 Request for Information. Direct comments and suggestions for improving this publication to:

Federal Aviation Administration
General Aviation and Commercial Division (AFS-800)
55 M Street SE, 8th Floor, Zone 1
Washington, DC 20003

CHAPTER 2. REFERENCES

2.1 Related Code of Federal Regulations (CFR) Parts. The following regulations and parts can be found at http://www.faa.gov/regulations_policies/faa_regulations/.

- Title 14 CFR Part 1, Definitions and Abbreviations.
- Title 14 CFR Part 48, Registration and Marking Requirements for Small Unmanned Aircraft.
- Title 14 CFR Part 71, Designation of Class A, B, C, D, and E Airspace Areas; Air Traffic Service Routes; and Reporting Points.
- Title 14 CFR Part 73, Special Use Airspace.
- Title 14 CFR Part 91, General Operating and Flight Rules.
- Title 14 CFR Part 93, Special Air Traffic Rules.
- Title 14 CFR Part 101, Moored Balloons, Kites, Amateur Rockets and Unmanned Free Balloons.
- Title 14 CFR Part 107, Small Unmanned Aircraft Systems.
- Title 47 CFR Part 87, Aviation Services.

2.2 Notices to Airmen (NOTAM). Information on how to obtain NOTAMs can be found at https://pilotweb.nas.faa.gov/PilotWeb/.

2.3 Related Reference Material. The following listed reference materials contain additional information necessary to ensure safe operations in the NAS. An sUAS operator may want to consider seeking out additional publications to supplement the lists below.

2.3.1 FAA ACs, Notices, and Orders (current editions). You can find the current editions of the following publications on the FAA Web sites: http://www.faa.gov/regulations_policies/advisory_circulars/ and http://www.faa.gov/regulations_policies/orders_notices/.

- AC 00-6, Aviation Weather.
- AC 00-45, Aviation Weather Services.
- AC 60-28, FAA English Language Skill Standards Required by 14 CFR Parts 61, 63, and 65.
- AC 120-92, Safety Management Systems for Aviation Service Providers.
- FAA Order JO 7110.10, Flight Services.
- FAA Order JO 7110.65, Air Traffic Control.
- FAA Order JO 7210.3, Facility Operation and Administration.
- FAA Order JO 7400.9, Airspace Designations and Reporting Points.

- FAA Order 8130.34, Airworthiness Certification of Unmanned Aircraft Systems and Optionally Piloted Aircraft.
- FAA Order 8900.1, Flight Standards Information Management System (FSIMS).

2.3.2 Additional FAA Online/Mobile Sources.

- UAS Web site: https://www.faa.gov/uas/.
- UAS Registration Web site: https://registermyuas.faa.gov/.
- B4UFLY mobile app.

2.3.3 FAA Handbooks, Manuals, and Other Publications. You can find the following handbooks, manuals, and other publications on the FAA Web site at http://www.faa.gov/regulations_policies/handbooks_manuals/.

- Aeronautical Information Manual (AIM): http://www.faa.gov/air_traffic/publications/.
- Aeronautical Charts (Hardcopy): http://faacharts.faa.gov/.
- Aeronautical Charts (Digital): http://www.faa.gov/air_traffic/flight_info/aeronav/digital_products/.
- Pilot/Controller Glossary: http://www.faa.gov/air_traffic/publications/.
- Pilot's Handbook of Aeronautical Knowledge: http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/.
- General Aviation Pilot's Guide to Preflight Weather Planning, Weather Self-Briefings, and Weather Decision Making: www.faa.gov/nextgen/update/media/ga_weather_decision_making.pdf.
- Risk Management Handbook: http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/media/faa-h-8083-2.pdf.
- FAA Small Unmanned Aircraft Systems Airman Certification Standards: (TBD).

2.3.4 RTCA, Inc. Documents (current editions). Copies of the current editions of the following RTCA, Inc. documents are available for purchase online at http://www.rtca.org.

- DO-178, Software Considerations in Airborne Systems and Equipment Certification.
- DO-304, Guidance Material and Considerations for Unmanned Aircraft Systems.

2.3.5 Public Law (PL). PL 112-95, Title III, Subtitle B—Unmanned Aircraft Systems.

CHAPTER 3. BACKGROUND

3.1 PL 112-95, Title III, Subtitle B. In 2012, Congress passed the FAA Modernization and Reform Act of 2012 (PL 112-95). PL 112-95, Section 333 directed the Secretary of Transportation to determine whether UAS operations posing the least amount of public risk and no threat to national security could safely be operated in the NAS and, if so, to establish requirements for the safe operation of these systems in the NAS, prior to completion of the UAS comprehensive plan and rulemakings required by PL 112-95, Section 332. On February 23, 2015, as part of its ongoing efforts to integrate UAS operations in the NAS and in accordance with PL 112-95, Section 333, the FAA issued a Notice of Proposed Rulemaking (NPRM) proposing to amend its regulations to adopt specific rules for the operation of sUAS in the NAS. Over 4,600 public comments were submitted in response to the NPRM. In consideration of the public comments, the FAA issued a final rule adding part 107, integrating civil sUAS into the NAS. Part 107 allows sUAS operations for many different non-hobby and nonrecreational purposes without requiring airworthiness certification, exemption, or a Certificate of Waiver or Authorization (COA). In addition, part 107 also applies to sUAS used for hobby or recreation that are not flown in accordance with part 101 subpart E (see paragraph 4.1).

3.2 Part 107—A Regulatory First Step. The FAA addresses aviation safety in three key areas: personnel, equipment, and operations. The FAA assesses each of these areas both independently to meet current regulations and standards, as well as collectively to ensure no conflicts exist overall that would create an unsafe condition. This approach allows the FAA to be flexible in responding to the needs of the aviation community while still being able to establish standards for future growth and development. To that end, part 107 contains subparts that focus on each of these key aviation safety areas specific to sUAS, and the chapters in this AC are organized in the same manner.

CHAPTER 4. PART 107 SUBPART A, GENERAL

4.1 Applicability. This chapter provides guidance regarding the applicability of part 107 to civil small UA operations conducted within the NAS. However, part 107 does not apply to the following:

1. Model aircraft that are operated in accordance with part 101 subpart E, Model Aircraft), which applies to model aircraft meeting all of the following criteria:
   - The aircraft is flown strictly for hobby or recreational use;
   - The aircraft is operated in accordance with a community-based set of safety guidelines and within the programming of a nationwide community-based organization;
   - The aircraft is limited to not more than 55 pounds unless otherwise certified through a design, construction, inspection, flight test, and operational safety program administered by a community-based organization;
   - The aircraft is operated in a manner that does not interfere with and gives way to any manned aircraft;
   - When flown within 5 miles of an airport, the operator of the aircraft provides the airport operator and the airport air traffic control (ATC) tower (when an air traffic facility is located at the airport) with prior notice of the operation;
   - The aircraft is capable of sustained flight in the atmosphere; and
   - The aircraft is flown within Visual Line of Sight (VLOS) of the person operating the aircraft.
2. Operations conducted outside the United States;
3. Amateur rockets;
4. Moored balloons;
5. Unmanned free balloons;
6. Kites;
7. Public aircraft operations; and
8. Air carrier operations.

4.2 Definitions. The following defined terms are used throughout this AC:

4.2.1 Control Station (CS). An interface used by the remote pilot or the person manipulating the controls to control the flight path of the small UA.

4.2.2 Corrective Lenses. Spectacles or contact lenses.

4.2.3 Model Aircraft. A UA that is:

- Capable of sustained flight in the atmosphere;
- Flown within VLOS of the person operating the aircraft; and
- Flown for hobby or recreational purposes.

4.2.4 Person Manipulating the Controls. A person other than the remote pilot in command (PIC) who is controlling the flight of an sUAS under the supervision of the remote PIC.

4.2.5 Remote Pilot in Command (Remote PIC or Remote Pilot). A person who holds a remote pilot certificate with an sUAS rating and has the final authority and responsibility for the operation and safety of an sUAS operation conducted under part 107.

4.2.6 Small Unmanned Aircraft (UA). A UA weighing less than 55 pounds, including everything that is onboard or otherwise attached to the aircraft, and can be flown without the possibility of direct human intervention from within or on the aircraft.

4.2.7 Small Unmanned Aircraft System (sUAS). A small UA and its associated elements (including communication links and the components that control the small UA) that are required for the safe and efficient operation of the small UA in the NAS.

4.2.8 Unmanned Aircraft (UA). An aircraft operated without the possibility of direct human intervention from within or on the aircraft.

4.2.9 Visual Observer (VO). A person acting as a flightcrew member who assists the small UA remote PIC and the person manipulating the controls to see and avoid other air traffic or objects aloft or on the ground.

4.3 Abbreviations/Acronyms Used in the Advisory Circular.

1. AC: advisory circular.
2. ACR: Airman Certification Representative.
3. AGL: above ground level.
4. ATC: air traffic control.
5. CFI: certificated flight instructor.
6. CFR: Code of Federal Regulations.
7. DPE: Designated Pilot Examiner.
8. FAA: Federal Aviation Administration.
9. FSDO: Flight Standards District Office.
10. GPS: Global Positioning System.
11. IACRA: Integrated Airmen Certification and/or Rating Application.
12. KTC: knowledge testing center.

13. MSL: mean sea level.
14. NOTAM: Notice to Airmen.
15. NAS: National Airspace System.
16. PIC: pilot in command.
17. UA: unmanned aircraft.
18. UAS: Unmanned Aircraft System.
19. U.S.C.: United States Code.
20. VO: visual observer.

4.4 Falsification, Reproduction, or Alteration. The FAA relies on information provided by owners and remote pilots of sUAS when it authorizes operations or when it has to make a compliance determination. Accordingly, the FAA may take appropriate action against an sUAS owner, operator, remote PIC, or anyone else who fraudulently or knowingly provides false records or reports, or otherwise reproduces or alters any records, reports, or other information for fraudulent purposes. Such action could include civil sanctions and the suspension or revocation of a certificate or waiver.

4.5 Accident Reporting. The remote PIC of the sUAS is required to report an accident to the FAA within 10 days if it meets any of the following thresholds:

1. At least serious injury to any person or any loss of consciousness. A serious injury is an injury that qualifies as Level 3 or higher on the Abbreviated Injury Scale (AIS) of the Association for the Advancement of Automotive Medicine (AAAM). The AIS is an anatomical scoring system that provides a means of ranking the severity of an injury and is widely used by emergency medical personnel. Within the AIS system, injuries are ranked on a scale of 1 to 6, with Level 1 being a minor injury, Level 2 is moderate, Level 3 is serious, Level 4 is severe, Level 5 is critical, and Level 6 is a nonsurvivable injury. The FAA currently uses serious injury (AIS Level 3) as an injury threshold in other FAA regulations.

   Note: It would be considered a "serious injury" if a person requires hospitalization, but the injury is fully reversible (including, but not limited to, head trauma, broken bone(s), or laceration(s) to the skin that requires suturing).

2. Damage to any property, other than the small UA, if the cost is greater than $500 to repair or replace the property (whichever is lower).

   Note: For example, a small UA damages a property whose fair market value is $200, and it would cost $600 to repair the damage. Because the fair market value is below $500, this accident is not required to be reported. Similarly, if the aircraft causes $200 worth of damage to property whose fair market value is $600, that accident is also not required to be reported because the repair cost is below $500.

4.5.1 Submitting the Report. The accident report must be made within 10 calendar-days of the operation that created the injury or damage. The report may be submitted to the appropriate FAA Regional Operations Center (ROC) electronically or by telephone. Electronic reporting can be completed at www.faa.gov/uas/. To make a report by phone, see Figure 4-1, FAA Regional Operations Centers Telephone List. Reports may also be made to the nearest jurisdictional FSDO (http://www.faa.gov/about/office_org/field_offices/fsdo/). The report should include the following information:

1. sUAS remote PIC's name and contact information;
2. sUAS remote PIC's FAA airman certificate number;
3. sUAS registration number issued to the aircraft, if required (FAA registration number);
4. Location of the accident;
5. Date of the accident;
6. Time of the accident;
7. Person(s) injured and extent of injury, if any or known;
8. Property damaged and extent of damage, if any or known; and
9. Description of what happened.

Figure 4-1. FAA Regional Operations Centers Telephone List

FAA REGIONAL OPERATIONS CENTERS	
LOCATION WHERE ACCIDENT OCCURRED:	**TELEPHONE:**
DC, DE, MD, NJ, NY, PA, WV, and VA	**404-305-5150**
AL, CT, FL, GA, KY, MA, ME, MS, NC, NH, PR, RI, SC, TN, VI, and VT	**404-305-5156**
AK, AS, AZ, CA, CO, GU, HI, ID, MP, MT, NV, OR, UT, WA, and WY	**425-227-1999**
AR, IA, IL, IN, KS, LA, MI, MN, MO, ND, NE, NM, OH, OK, SD, TX, and WI	**817-222-5006**

4.5.2 National Transportation Safety Board (NTSB) Reporting. In addition to the report submitted to the ROC, and in accordance with the criteria established by the NTSB, certain sUAS accidents must also be reported to the NTSB. For more information, visit www.ntsb.gov.

CHAPTER 5. PART 107 SUBPART B, OPERATING LIMITATIONS FOR SMALL UNMANNED AIRCRAFT SYSTEMS (sUAS)

5.1 Applicability. This chapter provides guidance regarding sUAS operating limitations and the responsibilities of the remote pilot in command (PIC), person manipulating the controls, visual observer (VO), and anyone else that may be directly participating in the sUAS operation. A person is also a direct participant in the sUAS operation if his or her involvement is necessary for the safe operation of the sUAS.

5.2 Aircraft Operation. Just like a manned-aircraft PIC, the remote PIC of an sUAS is directly responsible for, and is the final authority as to, the operation of that UAS. The remote PIC will have final authority over the flight. Additionally, a person manipulating the controls can participate in flight operations under certain conditions. It is important to note that a person may not operate or act as a remote PIC or VO in the operation of more than one UA at the same time. The following items describe the requirements for both a remote PIC and a person manipulating the controls:

5.2.1 Remote PIC. A person acting as a remote PIC of an sUAS in the National Airspace System (NAS) under part 107 must obtain a remote pilot certificate with an sUAS rating issued by the FAA prior to sUAS operation. The remote PIC must have this certificate easily accessible during flight operations. Guidance regarding remote pilot certification is found in Chapter 6, Part 107 Subpart C, Remote Pilot Certification. Again, the remote PIC will have the final authority and responsibility for the operation and safety of an sUAS operation conducted under part 107.

5.2.1.1 Additionally, part 107 permits transfer of control of an sUAS between certificated remote pilots. Two or more certificated remote pilots transferring operational control (i.e., the remote PIC designation) to each other may do so only if they are both capable of maintaining Visual Line of Sight (VLOS) of the UA and without loss of control (LOC). For example, one remote pilot may be designated the remote PIC at the beginning of the operation, and then at some point in the operation another remote pilot may take over as remote PIC by positively communicating that he or she is doing so. As the person responsible for the safe operation of the UAS, any remote pilot who will assume remote PIC duties should meet all of the requirements of part 107, including awareness of factors that could affect the flight.

5.2.2 Person Manipulating the Flight Controls. A person who does not hold a remote pilot certificate or a remote pilot that that has not met the recurrent testing/training requirements of part 107 may operate the sUAS under part 107, as long as he or she is directly supervised by a remote PIC and the remote PIC has the ability to immediately take direct control of the sUAS. This ability is necessary to ensure that the remote PIC can quickly address any hazardous situation before an accident occurs. The ability for the remote PIC to immediately take over the flight controls could be achieved by using a number of different methods. For example, the operation could involve a “buddy box” type system that uses two control stations (CS): one for the person manipulating the flight controls and one for the remote PIC that allows the remote PIC to override the other CS

and immediately take direct control of the small UA. Another method could involve the remote PIC standing close enough to the person manipulating the flight controls so as to be able to physically take over the CS from the other person. A third method could employ the use of an automation system whereby the remote PIC could immediately engage that system to put the small UA in a pre-programmed "safe" mode (such as in a hover, in a holding pattern, or "return home").

5.2.3 Autonomous Operations. An autonomous operation is generally considered an operation in which the remote pilot inputs a flight plan into the CS, which sends it to the autopilot onboard the small UA. During automated flight, flight control inputs are made by components onboard the aircraft, not from a CS. Thus, the remote PIC could lose the control link to the small UA and the aircraft would still continue to fly the programmed mission/return home to land. During automated flight, the remote PIC also must have the ability to change routing/altitude or command the aircraft to land immediately. The ability to direct the small UA may be through manual manipulation of the flight controls or through commands using automation.

5.2.3.1 The remote PIC must retain the ability to direct the small UA to ensure compliance with the requirements of part 107. There are a number of different methods that a remote PIC may utilize to direct the small UA to ensure compliance with part 107. For example, the remote pilot may transmit a command for the autonomous aircraft to climb, descend, land now, proceed to a new waypoint, enter an orbit pattern, or return to home. Any of these methods may be used to satisfactorily avoid a hazard or give right of way.

5.2.3.2 The use of automation does not allow a person to simultaneously operate more than one small UA.

5.3 Aeronautical Decision-Making (ADM) and Crew Resource Management (CRM). ADM is a systematic approach to the mental process used by pilots to consistently determine the best course of action in response to a given set of circumstances. A remote PIC uses many different resources to safely operate an sUAS and needs to be able to manage these resources effectively. CRM is a component of ADM, where the pilot of sUAS makes effective use of all available resources: human resources, hardware, and information. Many remote pilots operating under part 107 may use a VO, oversee other persons manipulating the controls of the small UA, or any other person who the remote PIC may interact with to ensure safe operations. Therefore, a remote PIC must be able to function in a team environment and maximize team performance. This skill set includes situational awareness, proper allocation of tasks to individuals, avoidance of work overloads in self and in others, and effectively communicating with other members of the crew, such as VOs and persons manipulating the controls of an sUAS. Appendix A, Risk Assessment Tools, contains expanded information on ADM and CRM, as well as sample risk assessment tools to aid in identifying hazards and mitigating risks.

5.4 Aircraft Registration. A small UA must be registered, as provided for in 14 CFR part 47 or part 48 prior to operating under part 107. Part 48 is the regulation that establishes the streamlined online registration option for sUAS that will be operated only within the

territorial limits of the United States. The online registration Web address is http://www.faa.gov/uas/registration/. Guidance regarding sUAS registration and marking may be found at http://www.faa.gov/licenses_certificates/aircraft_certification/aircraft_registry/. Alternatively, sUAS can elect to register under part 47 in the same manner as manned aircraft.

5.4.1 Registration of Foreign-Owned and Operated sUAS. If sUAS operations involve the use of foreign civil aircraft, the operator would need to obtain a Foreign Aircraft Permit pursuant to 14 CFR part 375, § 375.41 before conducting any commercial air operations under this authority. Foreign civil aircraft means, a) an aircraft of foreign registry that is not part of the armed forces of a foreign nation, or b) a U.S.-registered aircraft owned, controlled, or operated by persons who are not citizens or permanent residents of the United States. Application instructions are specified in § 375.43. Applications should be submitted by electronic mail to the Department of Transportation (DOT) Office of International Aviation, Foreign Air Carrier Licensing Division. Additional information can be obtained at https://cms.dot.gov/policy/aviation-policy/licensing/foreign-carriers.

5.5 sUAS Maintenance, Inspections, and Condition for Safe Operation. An sUAS must be maintained in a condition for safe operation. Prior to flight, the remote PIC is responsible for conducting a check of the sUAS and verifying that it is actually in a condition for safe operation. Guidance regarding how to determine that an sUAS is in a condition for safe operation is found in Chapter 7, sUAS Maintenance and Inspection.

5.6 Medical Condition. Being able to safely operate the sUAS relies on, among other things, the physical and mental capabilities of the remote PIC, person manipulating the controls, VO, and any other direct participant in the sUAS operation. Though the person manipulating the controls of an sUAS and VO are not required to obtain an airman medical certificate, they may not participate in the operation of an sUAS if they know or have reason to know that they have a physical or mental condition that could interfere with the safe operation of the sUAS.

5.6.1 Physical or Mental Incapacitations. Obvious examples of physical or mental incapacitations that could render a remote PIC, person manipulating the controls, or VO incapable of performing their sUAS operational duties include, but are not limited to, such things as:

1. The temporary or permanent loss of the dexterity necessary to operate the CS to safely control the small UA.
2. The inability to maintain the required “see and avoid” vigilance due to blurred vision.
3. The inability to maintain proper situational awareness of the small UA operations due to illness and/or medication(s), such as after taking medications with cautions not to drive or operate heavy machinery.
4. A debilitating physical condition, such as a migraine headache or moderate or severe body ache(s) or pain(s) that would render the remote PIC, person manipulating the controls, or VO unable to perform sUAS operational duties.

5. A hearing or speaking impairment that would inhibit the remote PIC, person manipulating the controls, and VO from effectively communicating with each other. In a situation such as this, the remote PIC must ensure that an alternative means of effective communication is implemented. For example, a person who is hearing impaired may be able to effectively use sign language to communicate.

5.7 VLOS Aircraft Operation. The remote PIC and person manipulating the controls must be able to see the small UA at all times during flight. Therefore, the small UA must be operated closely enough to the CS to ensure visibility requirements are met during small UA operations. This requirement also applies to the VO, if used during the aircraft operation. However, the person maintaining VLOS may have brief moments in which he or she is not looking directly at or cannot see the small UA, but still retains the capability to see the UA or quickly maneuver it back to VLOS. These moments can be for the safety of the operation (e.g., looking at the controller to see battery life remaining) or for operational necessity. For operational necessity, the remote PIC or person manipulating the controls may intentionally maneuver the UA so that he or she loses sight of it for brief periods of time. Should the remote PIC or person manipulating the controls lose VLOS of the small UA, he or she must regain VLOS as soon as practicable. For example, a remote PIC stationed on the ground utilizing a small UA to inspect a rooftop may lose sight of the aircraft for brief periods while inspecting the farthest point of the roof. As another example, a remote PIC conducting a search operation around a fire scene with a small UA may briefly lose sight of the aircraft while it is temporarily behind a dense column of smoke. However, it must be emphasized that even though the remote PIC may briefly lose sight of the small UA, he or she always has the see-and-avoid responsibilities set out in part 107, §§ 107.31 and 107.37. The circumstances of what would prevent a remote PIC from fulfilling those responsibilities will vary, depending on factors such as the type of UAS, the operational environment, and distance between the remote PIC and the UA. For this reason, there is no specific time interval that interruption of VLOS is permissible, as it would have the effect of potentially allowing a hazardous interruption or prohibiting a reasonable one. If VLOS cannot be regained, the remote PIC or person manipulating the controls should follow pre-determined procedures for a loss of VLOS. These procedures are determined by the capabilities of the sUAS and may include immediately landing the UA, entering hover mode, or returning to home sequence. Thus, the VLOS requirement would not prohibit actions such as scanning the airspace or briefly looking down at the small UA CS.

5.7.1 Unaided Vision. VLOS must be accomplished and maintained by unaided vision, except vision that is corrected by the use of eyeglasses (spectacles) or contact lenses. Vision aids, such as binoculars, may be used only momentarily to enhance situational awareness. For example, the remote PIC, person manipulating the controls, or VO may use vision aids to avoid flying over persons or conflicting with other aircraft. Similarly, first person view devices may be used during operations, but do not satisfy the VLOS requirement. While the rule does not set specific vision standards, the FAA recommends that remote PICs, persons manipulating the controls, and VOs maintain 20/20 distant vision acuity (corrected) and normal field of vision.

5.7.2 VO. The use of a VO is optional. The remote PIC may choose to use a VO to supplement situational awareness and VLOS. Although the remote PIC and person manipulating the controls must maintain the capability to see the UA, using one or more VOs allows the remote PIC and person manipulating the controls to conduct other mission-critical duties (such as checking displays) while still ensuring situational awareness of the UA. The VO must be able to effectively communicate:

- The small UA location, attitude, altitude, and direction of flight;
- The position of other aircraft or hazards in the airspace; and
- The determination that the UA does not endanger the life or property of another.

5.7.2.1 To ensure that the VO can carry out his or her duties, the remote PIC must ensure that the VO is positioned in a location where he or she is able to see the small UA sufficiently to maintain VLOS. The remote PIC can do this by specifying the location of the VO. The FAA also requires that the remote PIC and VO coordinate to 1) scan the airspace where the small UA is operating for any potential collision hazard, and 2) maintain awareness of the position of the small UA through direct visual observation. This would be accomplished by the VO maintaining visual contact with the small UA and the surrounding airspace, and then communicating to the remote PIC and person manipulating the controls the flight status of the small UA and any hazards which may enter the area of operation, so that the remote PIC or person manipulating the controls can take appropriate action.

5.7.2.2 To make this communication possible, the remote PIC, person manipulating the controls, and VO must work out a method of effective communication, which does not create a distraction and allows them to understand each other. The communication method must be determined prior to operation. This effective communication requirement would permit the use of communication-assisting devices, such as a hand-held radio, to facilitate communication from a distance.

5.8 Operation Near Airports; in Certain Airspace; in Prohibited or Restricted Areas; or in the Proximity of Certain Areas Designated by a Notice to Airmen (NOTAM). Though many sUAS operations will occur in uncontrolled airspace, there are some that may need to operate in controlled airspace. Operations in Class B, Class C, or Class D airspace, or within the lateral boundaries of the surface area of Class E airspace designated for an airport, are not allowed unless that person has prior authorization from air traffic control (ATC). The link to the current authorization process can be found at www.faa.gov/uas/. The sUAS remote PIC must understand airspace classifications and requirements. Failure to do so would be in violation of the part 107 regulations and may potentially have an adverse safety effect. Although sUAS will not be subject to part 91, the equipage and communications requirements outlined in part 91 were designed to provide safety and efficiency in controlled airspace. Accordingly, while sUAS operating under part 107 are not subject to part 91, as a practical matter, ATC authorization or clearance may depend on operational parameters similar to those found in part 91. The

FAA has the authority to approve or deny aircraft operations based on traffic density, controller workload, communication issues, or any other type of operations that could potentially impact the safe and expeditious flow of air traffic in that airspace. Those planning sUAS operations in controlled airspace are encouraged to contact the FAA as early as possible. (For suggested references, please see paragraph 2.3.)

5.8.1 Small UA Operations Near an Airport—Notification and Permissions. Unless the flight is conducted within controlled airspace, no notification or authorization is necessary to operate at or near an airport. When operating in the vicinity of an airport, the remote PIC must be aware of all traffic patterns and approach corridors to runways and landing areas. The remote PIC must avoid operating anywhere that the presence of the sUAS may interfere with operations at the airport, such as approach corridors, taxiways, runways, or helipads. Furthermore, the remote PIC must yield right-of-way to all other aircraft, including aircraft operating on the surface of the airport.

5.8.1.1 Remote PICs are prohibited from operating their small UA in a manner that interferes with operations and traffic patterns at airports, heliports, and seaplane bases. While a small UA must always yield right-of-way to a manned aircraft, a manned aircraft may alter its flightpath, delay its landing, or take off in order to avoid an sUAS that may present a potential conflict or otherwise affect the safe outcome of the flight. For example, a UA hovering 200 feet above a runway may cause a manned aircraft holding short of the runway to delay takeoff, or a manned aircraft on the downwind leg of the pattern to delay landing. While the UA in this scenario would not pose an immediate traffic conflict to the aircraft on the downwind leg of the traffic pattern or to the aircraft intending to take off, nor would it violate the right-of-way provision of § 107.37(a), the small UA would have interfered with the operations of the traffic pattern at an airport.

5.8.1.2 In order to avoid interfering with operations in a traffic pattern, remote PICs should avoid operating in the traffic pattern or published approach corridors used by manned aircraft. When operational necessity requires the remote PIC to operate at an airport in uncontrolled airspace, the remote PIC should operate the small UA in such a way that the manned aircraft pilot does not need to alter his or her flightpath in the traffic pattern or on a published instrument approach in order to avoid a potential collision. Because remote PICs have an obligation to yield right-of-way to all other aircraft and avoid interfering in traffic pattern operations, the FAA expects that most remote PICs will avoid operating in the vicinity of airports because their aircraft generally do not require airport infrastructure, and the concentration of other aircraft increases in the vicinity of airports.

5.8.2 Air Traffic Organization (ATO). The ATO does not have the authority to deny sUAS operations on the basis of equipage that exceeds the part 107 requirements. Because additional equipage and technologies, such as geo-fencing, have not been certificated by the FAA, they need to be examined on a case-by-case basis in order for the FAA to determine their reliability and functionality. Additionally, requiring ATC to review

equipage would place a burden on ATC and detract from other duties. Instead, a remote pilot who wishes to operate in controlled airspace because he or she can demonstrate mitigations through equipage may do so by applying for a waiver (see paragraph 5.19).

5.8.3 Recurring or Long-Term Operations. For recurring or long-term operations in a given volume of controlled airspace, prior authorization could perhaps include a letter of agreement (LOA) to identify shortfalls and establish operating procedures for sUAS. This LOA will outline the ability to integrate into the existing air traffic operation and may improve the likelihood of access to the airspace where operations are proposed. This agreement will ensure all parties involved are aware of limitations and conditions and will enable the safe flow of aircraft operations in that airspace. For short-term or short-notice operations proposed in controlled airport airspace, a LOA may not be feasible. Prior authorization is required in all cases.

5.8.4 Temporary Flight Restrictions. Certain temporary flight restrictions (http://tfr.faa.gov/tfr2/list.html) may be imposed by way of a NOTAM (https://pilotweb.nas.faa.gov/PilotWeb/). Therefore, it is necessary for the sUAS remote PIC to check for NOTAMs before each flight to determine if there are any applicable airspace restrictions.

5.8.5 Type of Airspace. It is important that sUAS remote PICs also be aware of the type of airspace in which they will be operating their small UA. Referring to the B4UFly app or a current aeronautical chart (http://faacharts.faa.gov/) of the intended operating area will aid the sUAS remote PIC's decisionmaking regarding operations in the NAS.

5.9 Preflight Familiarization, Inspection, and Actions for Aircraft Operation. The remote PIC must complete a preflight familiarization, inspection, and other actions, such as crewmember briefings, prior to beginning flight operations. The FAA has produced many publications providing in-depth information on topics such as aviation weather, aircraft loading and performance, emergency procedures, ADM, and airspace, which should all be considered prior to operations (see paragraph 5.20). Additionally, all remote pilots are encouraged to review FAA publications (see paragraph 2.3).

5.9.1 Prior to Flight. The remote PIC must:

1. Conduct an assessment of the operating environment. The assessment must include at least the following:
    - Local weather conditions,
    - Local airspace and any flight restrictions,
    - The location of persons and property on the surface, and
    - Other ground hazards.

2. Ensure that all persons directly participating in the small UA operation are informed about the following:
    - Operating conditions,
    - Emergency procedures,
    - Contingency procedures,
    - Roles and responsibilities of each person involved in the operation, and
    - Potential hazards.
3. Ensure that all control links between the CS and the small UA are working properly. For example, before each flight, the remote PIC must determine that the small UA flight control surfaces necessary for the safety of flight are moving correctly through the manipulation of the small UA CS. If the remote PIC observes that one or more of the control surfaces are not responding correctly to CS inputs, then the remote PIC may not conduct flight operations until correct movement of all flight control surface(s) is established.
4. Ensure there is sufficient power to continue controlled flight operations to a normal landing. One of the ways that this could be done is by following the sUAS manufacturer's operating manual power consumption tables. Another method would be to include a system on the sUAS that detects power levels and alerts the remote pilot when remaining aircraft power is diminishing to a level that is inadequate for continued flight operation.
5. Ensure that any object attached or carried by the small UA is secure and does not adversely affect the flight characteristics or controllability of the aircraft.
6. Ensure that all necessary documentation is available for inspection, including the remote PIC's remote pilot certificate, aircraft registration (if required), and Certificate of Waiver (CoW) (if applicable).

5.9.2 Safety Risk Assessment. These preflight familiarizations, inspections, and actions can be accomplished as part of an overall safety risk assessment. The FAA encourages the remote PIC to conduct the overall safety risk assessment as a method of compliance with the prohibition on operations over certain persons and the requirement to remain clear of other aircraft, which are discussed in paragraphs 5.11 and 5.12. Appendix A provides additional guidance on how to conduct an overall safety risk assessment.

5.10 Operating Limitations for Small UA. The small UA must be operated in accordance with the following limitations:

- Cannot be flown faster than a groundspeed of 87 knots (100 miles per hour);
- Cannot be flown higher than 400 feet above ground level (AGL), unless flown within a 400-foot radius of a structure and does not fly higher than 400 feet above the structure's immediate uppermost limit;
- Minimum visibility, as observed from the location of the CS, may not be less than 3 statute miles (sm); and

- Minimum distance from clouds being no less than 500 feet below a cloud and no less than 2000 feet horizontally from the cloud.

Note: These operating limitations are intended, among other things, to support the remote pilot's ability to identify hazardous conditions relating to encroaching aircraft or persons on the ground, and to take the appropriate actions to maintain safety.

5.10.1 Determining Groundspeed. There are many different types of sUAS and different ways to determine groundspeed. Therefore, this guidance will only touch on some of the possible ways for the remote PIC to ensure that the small UA does not exceed a groundspeed of 87 knots during flight operations. Some of the possible ways to ensure that 87 knots is not exceeded are as follows:

- Installing a Global Positioning System (GPS) device on the small UA that reports groundspeed information to the remote pilot, wherein the remote pilot takes into account the wind direction and speed and calculates the small UA airspeed for a given direction of flight, or
- Timing the groundspeed of the small UA when it is flown between two or more fixed points, taking into account wind speed and direction between each point, then noting the power settings of the small UA to operate at or less than 87 knots groundspeed, or
- Using the small UA's manufacturer design limitations (e.g., installed groundspeed limiters).

5.10.2 Determining Altitude. In order to comply with the maximum altitude requirements of part 107, as with determining groundspeed, there are multiple ways to determine a small UA's altitude above the ground or structure. Some possible ways for a remote pilot to determine altitude are as follows:

- Installing a calibrated altitude reporting device on the small UA that reports the small UA altitude above mean sea level (MSL) to the remote pilot, wherein the remote pilot subtracts the MSL elevation of the CS from the small UA reported MSL altitude to determine the small UA AGL altitude above the terrain or structure;
- Installing a GPS device on the small UA that also has the capability of reporting MSL altitude to the remote pilot;
- With the small UA on the ground, have the remote pilot and VO pace off 400 feet from the small UA to get a visual perspective of the small UA at that distance, wherein the remote pilot and VO maintain that visual perspective or closer while the small UA is in flight; or
- Using the known height of local rising terrain and/or structures as a reference.

5.10.3 Visibility and Distance from Clouds. Once the remote PIC and VO have been able to reliably establish the small UA AGL altitude, it is incumbent on the remote PIC to determine that visibility from the CS is at least 3 sm and that the small UA is kept at least 500 feet below a cloud and at least 2,000 feet horizontally from a cloud. One of the ways

to ensure adherence to the minimum visibility and cloud clearance requirements is to obtain local aviation weather reports that include current and forecast weather conditions. If there is more than one local aviation reporting station near the operating area, the remote PIC should choose the closest one that is also the most representative of the terrain surrounding the operating area. If local aviation weather reports are not available, then the remote PIC may not operate the small UA if he or she is not able to determine the required visibility and cloud clearances by other reliable means. It is imperative that the UA not be operated above any cloud, and that there are no obstructions to visibility, such as smoke or a cloud, between the UA and the remote PIC.

5.11 Prohibited Operation Over Persons. Part 107 prohibits a person from flying a small UA directly over a person who is not under a safe cover, such as a protective structure or a stationary vehicle. However, a small UA may be flown over a person who is directly participating in the operation of the sUAS, such as the remote PIC, other person manipulating the controls, a VO, or crewmembers necessary for the safety of the sUAS operation, as assigned and briefed by the remote PIC. There are several ways that the sUAS remote PIC can comply with these requirements, such as:

- Selecting an operational area (site) that is clearly unpopulated/uninhabited. If selecting a site that is populated/inhabited, have a plan of action which ensures persons remain clear of the operating area, remain indoors, or remain under safe cover until such time that the small UA flight has ended. Safe cover is a structure or stationary vehicle that would protect a person from harm if the small UA were to crash into that structure or vehicle;
- Establishing an operational area in which the remote PIC has taken reasonable precautions to keep free of persons not directly participating in the operation of the sUAS;
- Choosing an operating area that is sparsely populated, or, ideally, clear of persons if operating a small UA from a moving vehicle;
- Having a plan of action that ensures the small UA remains clear of persons who may enter the operating area.
- Adopt an appropriate operating distance from persons not directly participating in the operation of the sUAS.

5.12 Remaining Clear of Other Aircraft. A remote PIC has a responsibility to operate the small UA so it remains clear of and yields to all other aircraft. This is traditionally referred to as “see and avoid.” To satisfy this responsibility, the remote PIC must know the location and flight path of his or her small UA at all times. The remote PIC must be aware of other aircraft, persons, and property in the vicinity of the operating area, and maneuver the small UA to avoid a collision, as well as prevent other aircraft from having to take action to avoid the small UA.

5.13 Operations from Moving Vehicles. Part 107 permits operation of an sUAS from a moving land or water-borne vehicle over a sparsely-populated area. However, operation from a moving aircraft is prohibited. Additionally, small UA transporting another

person's property for compensation or hire may not be operated from any moving vehicle.

5.13.1 Waiving the Sparsely-Populated Area Provision. Although the regulation states that operations from a moving vehicle may only be conducted over a sparsely-populated area, this provision may be waived (see paragraph 5.19). The operation is subject to the same restrictions that apply to all other part 107 operations. For instance, the remote PIC operating from a moving vehicle is still required to maintain VLOS and operations are still prohibited over persons not directly involved in the operation of the sUAS unless under safe cover. The remote PIC is also responsible for ensuring that no person is subject to undue risk as a result of LOC of the small UA for any reason. If a VO is not located in the same vehicle as the remote PIC, the VO and remote PIC must still maintain effective communication.

5.13.2 Careless or Reckless Operation of sUAS. Part 107 also prohibits careless or reckless operation of an sUAS. Flying an sUAS while driving a moving vehicle is considered to be careless or reckless because the person's attention would be hazardously divided. Therefore, the remote PIC or person manipulating the flight controls cannot operate an sUAS and drive a moving vehicle in a safe manner and remain in compliance with part 107.

5.13.3 Applicable Laws. Other laws, such as state and local traffic laws, may also apply to the conduct of a person driving a vehicle. Many states currently prohibit distracted driving and state or local laws may also be amended in the future to impose restrictions on how cars and public roads may be used with regard to an sUAS operation. The FAA emphasizes that people involved in an sUAS operation are responsible for complying with all applicable laws and not just the FAA's regulations.

5.14 Transportation of Property. Part 107 permits transportation of property by sUAS for compensation or hire. These operations must be conducted within a confined area and in compliance with the operating restrictions of part 107. When conducting the transportation of property, the transport must occur wholly within the bounds of a state. It may not involve transport between, 1) Hawaii and another place in Hawaii through airspace outside Hawaii, 2) the District of Columbia (DC) and another place in DC, or 3) a territory or possession of the United States and another place in the same territory or possession, as this is defined by statute as interstate air transportation.

5.14.1 Limitations. As with other operations in part 107, sUAS operations involving the transport of property must be conducted within VLOS of the remote pilot. While the VLOS limitation can be waived for some operations under the rule, it cannot for transportation of property. Additionally, part 107 does not allow the operation of an sUAS from a moving vehicle or aircraft if the small UA is being used to transport property for compensation or hire. This limitation cannot be waived. The maximum total weight of the small UA (including any property being transported) is limited to under 55 pounds. Additionally, other provisions of part 107 require the remote pilot to know the UA's location; to determine the UA's attitude, altitude, and direction; to yield the right-of-way to other aircraft; and to maintain the ability to see and avoid other aircraft.

5.14.2 Hazardous Materials. Part 107 does not allow the carriage of hazardous materials because the carriage of hazardous materials poses a higher level of risk.

5.15 Operations while Impaired. Part 107 does not allow operation of an sUAS if the remote PIC, person manipulating the controls, or VO is unable to safely carry out his or her responsibilities. It is the remote PIC's responsibility to ensure all crewmembers are not participating in the operation while impaired. While drug and alcohol use are known to impair judgment, certain over-the-counter medications and medical conditions could also affect the ability to safely operate a small UA. For example, certain antihistamines and decongestants may cause drowsiness. We also emphasize that part 107 prohibits a person from serving as a remote PIC, person manipulating the controls, VO, or other crewmember if he or she:

- Consumed any alcoholic beverage within the preceding 8 hours;
- Is under the influence of alcohol;
- Has a blood alcohol concentration of .04 percent or greater; and/or
- Is using a drug that affects the person's mental or physical capabilities.

5.15.1 Medical Conditions. Certain medical conditions, such as epilepsy, may also create a risk to operations. It is the remote PIC's responsibility to determine that their medical condition is under control and they can safely conduct a UAS operation.

5.16 Daylight Operations. Part 107 prohibits operation of an sUAS at night, which is defined in part 1 as the time between the end of evening civil twilight and the beginning of morning civil twilight, as published in The Air Almanac, converted to local time. In the continental United States (CONUS), evening civil twilight is the period of sunset until 30 minutes after sunset and morning civil twilight is the period of 30 minutes prior to sunrise until sunrise. In Alaska, the definition of civil twilight differs and is described in The Air Almanac. The Air Almanac provides tables which are used to determine sunrise and sunset at various latitudes. These tables can also be downloaded from the Naval Observatory and customized for your location. The link for the Naval Observatory is http://aa.usno.navy.mil/publications/docs/aira.php.

5.16.1 Civil Twilight Operations. When sUAS operations are conducted during civil twilight, the small UA must be equipped with anticollision lights that are capable of being visible for at least 3 sm. However, the remote PIC may reduce the visible distance of the lighting less than 3 sm during a given flight if he or she has determined that it would be in the interest of safety to do so, for example if it impacts his or her night vision. sUAS not operated during civil twilight are not required to be equipped with anti-collision lighting.

5.17 In-Flight Emergency. An in-flight emergency is an unexpected and unforeseen serious occurrence or situation that requires urgent, prompt action. In case of an in-flight emergency, the remote PIC is permitted to deviate from any rule of part 107 to the extent necessary to respond to that emergency. A remote PIC who exercises this emergency power to deviate from the rules of part 107 is required, upon FAA request, to send a

written report to the FAA explaining the deviation. Emergency action should be taken in such a way as to minimize injury or damage to property.

5.18 Careless or Reckless Operation. As with manned aircraft, remote PICs are prohibited from engaging in a careless or reckless operation. We also note that because sUAS have additional operating considerations that are not present in manned aircraft operations, there may be additional activity that would be careless or reckless if conducted using an sUAS. For example, failure to consider weather conditions near structures, trees, or rolling terrain when operating in a densely populated area could be determined as careless or reckless operation.

5.19 Certificate of Waiver. Part 107 includes the option to apply for a Certificate of Waiver (CoW). This CoW will allow an sUAS operation to deviate from certain provisions of part 107 if the Administrator finds that the proposed operation can be safely conducted under the terms of that CoW. A list of the waivable sections of part 107 can be found in § 107.205 and are listed below:

- Section 107.25, Operation from a moving vehicle or aircraft. However, no waiver of this provision will be issued to allow the carriage of property of another by aircraft for compensation or hire.
- Section 107.29, Daylight operation.
- Section 107.31, Visual line of sight aircraft operation. However, no waiver of this provision will be issued to allow the carriage of property of another by aircraft for compensation or hire.
- Section 107.33, Visual observer.
- Section 107.35, Operation of multiple small unmanned aircraft systems.
- Section 107.37(a), Yielding the right of way.
- Section 107.39, Operation over people.
- Section 107.41, Operation in certain airspace.
- Section 107.51, Operating limitations for small unmanned aircraft.

5.19.1 Applying for a CoW. To apply for a CoW under § 107.200, an applicant must go to www.faa.gov/uas/ and follow the instructions.

5.19.2 Application Process. The application must contain a complete description of the proposed operation and a justification, including supporting data and documentation (as necessary), that establishes that the proposed operation can safely be conducted under the terms of a CoW. Although not required by part 107, the FAA encourages applicants to submit their application at least 90 days prior to the start of the proposed operation. The FAA will strive to complete review and adjudication of waivers within 90 days; however, the time required for the FAA to make a determination regarding waiver requests will vary based on the complexity of the request. The amount of data and analysis required as part of the application will be proportional to the specific relief that is requested. For example, a

request to waive several sections of part 107 for an operation that takes place in a congested metropolitan area with heavy air traffic will likely require significantly more data and analysis than a request to waive a single section for an operation that takes place in a sparsely-populated area with minimal air traffic. If a CoW is granted, that certificate may include specific special provisions designed to ensure that the sUAS operation may be conducted as safely as one conducted under the provisions of part 107. A listing of standard special provisions for part 107 waivers will be available on the FAA's Web site at http://www.faa.gov/uas/.

5.20 Supplemental Operational Information. Appendix B, Supplemental Operational Information, contains expanded information regarding operational topics that should be considered prior to operations.

CHAPTER 6. PART 107 SUBPART C, REMOTE PILOT CERTIFICATION

6.1 Applicability. This chapter provides guidance regarding the airman certification requirements and procedures for persons acting as remote pilot in command (PIC) of a small UA operated in the National Airspace System (NAS). In the aviation context, the FAA typically refers to "licensing" as "certification."

6.2 Remote Pilot Certification. A person exercising the authority of PIC in compliance with part 107 is considered a "remote pilot in command" (remote PIC). As such, prior to acting as remote PIC, he or she must obtain a remote pilot certificate with an sUAS rating.

6.3 Eligibility. A person applying for a remote pilot certificate with an sUAS rating must meet and maintain the following eligibility requirements, as applicable:

- Be at least 16 years of age.
- Be able to read, speak, write, and understand the English language. However, the FAA may make an exception if the person is unable to meet one of these requirements due to medical reasons, such as a hearing impairment.
- Be in a physical and mental condition that would not interfere with the safe operation of an sUAS.
- Pass the initial aeronautical knowledge test at an FAA-approved knowledge testing center (KTC). However, a person who already holds a pilot certificate issued under 14 CFR part 61, except a student pilot certificate, and has successfully completed a flight review in accordance with part 61 within the previous 24 calendar-months is only required to successfully complete a part 107 online training course, found at www.faasafety.gov. For more information concerning aeronautical knowledge tests and training, see paragraph 6.6.

6.4 Application Process. This paragraph provides guidance on how a person can apply for a remote pilot certificate.

6.4.1 Applicants Without Part 61 Certificates. A person who does not have a part 61 pilot certificate or a part 61 certificate holder who has not completed a part 61 flight review in the previous 24 calendar-months must use the following process. A part 61 pilot who has completed a flight review within the previous 24 calendar-months may elect to use this process.

1. Pass an initial aeronautical knowledge test administered at a KTC (see paragraph 6.6).
2. Complete the Remote Pilot Certificate and/or Rating Application for a remote pilot certificate (FAA Form 8710-13).

    - **Option 1 (Online Form)**: This is the fastest and simplest method. The FAA Form 8710-13 application should be completed online using the electronic FAA Integrated Airmen Certificate and/or Rating Application (IACRA) system

(https://iacra.faa.gov/iacra/). The applicant must have already passed an initial aeronautical knowledge test. Once registered with IACRA, he or she will login with their username and password. Click on "Start New Application" and, 1) Application Type "Pilot", 2) Certifications "Remote Pilot," 3) "Other Path Information," and 4) "Start Application." Continue through the application process and, when prompted, the applicant will enter the 17-digit Knowledge Test Exam ID from the knowledge test in IACRA. It may take up to 48 hours from the test date for the knowledge test to appear in IACRA. The KTC test proctor will be the one that verified the identity of the applicant. Once the applicant completes the online application in IACRA, he or she will sign the application electronically and submit it to the Airman Registry for processing. No FAA representative will be required to sign the application if the applicant was able to self-certify.

Note: When the applicant uses this online option, the application will be transmitted electronically from the applicant to the Airman Registry. The only electronic signature that will be reflected on the IACRA application will be the applicant's. The applicant will then receive a confirmation email once his or her application has completed the Transportation Security Administration (TSA) vetting process. The email will provide information that will allow the applicant to log into the IACRA system and print a copy of the temporary certificate.

- **Option 2 (Paper Application)**: An applicant could also submit a paper application. If the applicant chooses the paper method, the original initial aeronautical knowledge test report must be mailed with the application to the following address:

DOT/FAA
Airmen Certification Branch (AFS-760)
P.O. Box 25082
Oklahoma City, OK 73125

Note: A temporary airman certificate will not be provided to the remote pilot applicant if they do not hold a part 61 certificate. For this reason, it would be of the applicant's best interest to utilize Option 1 (IACRA system) instead of the paper method, in order to receive a temporary airman certificate once the application has completed the TSA vetting process.

3. Receive permanent remote pilot certificate once all other FAA internal processing is complete.

6.4.2 Applicants with Part 61 Certificates. Instead of the process described above, a person who holds a part 61 pilot certificate, except a student pilot certificate, and has completed a flight review within the previous 24 calendar-months may elect to apply using the following process:

1. Complete the online course (Part 107 small Unmanned Aircraft Systems (sUAS), ALC-451) located within the FAA Safety Team (FAASTeam) Web site (www.faasafety.gov) and receive a completion certificate.
2. Complete the Remote Pilot Certificate and/or Rating Application for a remote pilot certificate (FAA Form 8710-13).
    - **Option 1 (Online Application)**: In almost all cases, the application should be completed online using the electronic FAA IACRA system (https://iacra.faa.gov/iacra/). The applicant must include verification that he or she completed the online course or passed an initial aeronautical knowledge test. The applicable official document(s) must be uploaded into IACRA either by the applicant or the certifying officer.
    - **Option 2 (Paper)**: The application may be completed on paper. Using this method, the certificate of completion for the online course or original initial aeronautical knowledge test report must be included with the application. Please note that the processing time will be increased if a paper application is used.
3. Contact a FSDO, an FAA DPE, an ACR, or an FAA CFI to make an appointment to validate the applicant's identification. The applicant must present the completed FAA Form 8710-13 along with the online course completion certificate or knowledge test report (as applicable) and proof of a current flight review. The FAA Form 8710-13 application will be signed by the applicant after the FSDO, DPE, ACR, or CFI examines the applicant's photo identification and verifies the applicant's identity. The FAA representative will then sign the application. The identification presented must include a photograph of the applicant, the applicant's signature, and the applicant's actual residential address (if different from the mailing address). This information may be presented in more than one form of identification. Acceptable methods of identification include, but are not limited to U.S. drivers' licenses, government identification cards, passports, and military identification cards (refer to AC 61-65). If using paper or IACRA method, an appropriate FSDO representative, a DPE, or an ACR will issue the applicant a temporary airman certificate.

    Note: A CFI is not authorized to issue a temporary certificate. They can process applications for applicants who do not need a temporary certificate. If using IACRA and the applicant is utilizing a CFI as the FAA representative, the applicant can print their own temporary airman certificate after receiving an email from the FAA notifying them that it is available. If using the paper method and the applicant is utilizing a CFI as the FAA representative, the applicant will not be issued a temporary airman certificate. Once the FSDO has signed and approved the application, it will be mailed to the Registry for the issuance of the permanent certificate.

4. Receive permanent remote pilot certificate once all other FAA internal processing is complete.

6.5 Security Disqualification. After the FAA receives the application, the TSA will automatically conduct a background security screening of the applicant prior to issuance of a remote pilot certificate. If the security screening is successful, the FAA will issue a permanent remote pilot certificate. If the security screening is not successful, the applicant will be disqualified and a temporary pilot certificate will not be issued. Individuals who believe that they improperly failed a security threat assessment may appeal the decision to the TSA.

6.6 Aeronautical Knowledge Tests (Initial and Recurrent). It is important to have and retain the knowledge necessary to operate a small UA in the NAS. This aeronautical knowledge can be obtained through self-study, taking an online training course, taking an in-person training course, or any combination thereof. The FAA has published the Small Unmanned Aircraft Systems Airman Certification Standard (https://www.faa.gov/training_testing/testing/acs/) that provides the necessary reference material.

> **Note:** The below information regarding initial and recurrent knowledge tests apply to persons who do not hold a current part 61 airman certificate.

6.6.1 Initial Test. As described in paragraph 6.4, a person applying for remote pilot certificate with an sUAS rating must pass an initial aeronautical knowledge test given by an FAA-approved KTC. The initial knowledge test will cover the aeronautical knowledge areas listed below:

1. Applicable regulations relating to sUAS rating privileges, limitations, and flight operation;
2. Airspace classification and operating requirements, and flight restrictions affecting small UA operation;
3. Aviation weather sources and effects of weather on small UA performance;
4. Small UA loading and performance;
5. Emergency procedures;
6. Crew Resource Management (CRM);
7. Radio communication procedures;
8. Determining the performance of small UA;
9. Physiological effects of drugs and alcohol;
10. Aeronautical decision-making (ADM) and judgment;
11. Airport operations; and
12. Maintenance and preflight inspection procedures.

6.6.1.1 A part 61 certificate holder who has completed a flight review within the previous 24 calendar-months may complete an initial online training course instead of taking the knowledge test (see paragraph 6.7).

6.6.1.2 Additional information on some of the knowledge areas listed above can be found in Appendix B.

6.6.2 Recurrent Test. After a person receives a remote pilot certificate with an sUAS rating, that person must retain and periodically update the required aeronautical knowledge to continue to operate a small UA in the NAS. To continue exercising the privileges of a remote pilot certificate, the certificate holder must pass a recurrent aeronautical knowledge test within 24 calendar-months of passing either an initial or recurrent aeronautical knowledge test. A part 61 pilot certificate holder who has completed a flight review within the previous 24 calendar-months may complete a recurrent online training course instead of taking the knowledge test.

6.6.2.1 Figure 6-1, Recurrent Test Cycle Examples, illustrates an individual's possible renewal cycles.

Figure 6-1. Recurrent Test Cycle Examples

Person passes an initial aeronautical knowledge test on September 13, 2016.	then	Recurrent knowledge test must be passed no later than September 30, 2018, which does not exceed 24 calendar-months.
Person does not pass recurrent knowledge test until October 5, 2018.	then	Person may not exercise the privileges of the remote pilot certificate between October 1, 2018, and October 5, 2018, when the test is passed. The next recurrent knowledge test must be passed no later than October 31, 2020, which does not exceed 24 calendar-months.
Person elects to take recurrent knowledge test prior to October 2020. The recurrent knowledge test is taken and passed on July 15, 2020.	then	The next recurrent knowledge test must be passed no later than July 31, 2022, which does not exceed 24 calendar-months.

6.6.2.2 The recurrent aeronautical knowledge test areas are as follows:

1. Applicable regulations relating to sUAS rating privileges, limitations, and flight operation;
2. Airspace classification and operating requirements and flight restrictions affecting small UA operation;
3. Emergency procedures;
4. CRM;
5. ADM and judgment;

6. Airport operations; and
7. Maintenance and preflight inspection procedures.

6.6.3 Test Providers. KTCs will administer initial and recurrent examinations provided by the FAA. In order to take an aeronautical knowledge test, an applicant will be required to schedule an appointment with the KTC providing proper government-issued photo identification to the KTC on the day of scheduled testing. The location of the closest KTC can be found at http://www.faa.gov/training_testing/testing/media/test_centers.pdf.

6.7 Aeronautical Knowledge Training Course (Initial and Recurrent). This section is applicable only to persons who hold a part 61 airman certificate, other than a student pilot certificate, and have a current flight review.

6.7.1 Initial Training Course. As described in paragraph 6.4, a pilot applying for a remote pilot certificate may complete an initial training course instead of the knowledge test. The training course can be taken online at www.faasafety.gov. The initial training course will cover the aeronautical knowledge areas listed below:

1. Applicable regulations relating to sUAS rating privileges, limitations, and flight operation;
2. Effects of weather on small UA performance;
3. Small UA loading and performance;
4. Emergency procedures;
5. CRM;
6. Determining the performance of small UA; and
7. Maintenance and preflight inspection procedures.

Note: Additional information on some of the knowledge areas listed above can be found in Appendix B.

6.7.2 Recurrent Training Course. After a pilot receives a remote pilot certificate with an sUAS rating, that person must retain and periodically update the required aeronautical knowledge to continue to operate a small UA in the NAS. As a renewal process, the remote pilot must complete either a recurrent training course or a recurrent knowledge test within 24 calendar-months of passing either an initial or recurrent aeronautical knowledge test. Figure 6-2, Recurrent Training Course Cycle Examples, illustrates an individual's possible renewal cycles.

Figure 6-2. Recurrent Training Course Cycle Examples

Person passes an initial aeronautical knowledge test on September 13, 2016.	then	Recurrent training course must be completed no later than September 30, 2018, which does not exceed 24 calendar-months.
Person does not complete recurrent training course until October 5, 2018.	then	Person may not exercise the privileges of the remote pilot certificate between October 1, 2018, and October 5, 2018, when the course is completed. The next recurrent training course must be completed no later than October 31, 2020, which does not exceed 24 calendar-months.
Person elects to complete recurrent training course prior to October 2020. The recurrent training course is taken and completed on July 15, 2020.	then	The next recurrent training course must be completed no later than July 31, 2022, which does not exceed 24 calendar-months.

6.7.2.1 The recurrent training course areas are as follows:

1. Applicable regulations relating to sUAS rating privileges, limitations, and flight operation;
2. Emergency procedures;
3. CRM; and
4. Maintenance and preflight inspection procedures.

CHAPTER 7. sUAS MAINTENANCE AND INSPECTION

7.1 Applicability. Section 107.15 requires the remote PIC to perform checks of the UA prior to each flight to determine if the sUAS is in a condition for safe operation. This chapter provides guidance on how to inspect and maintain an sUAS. Additionally, Appendix C, sUAS Maintenance and Inspection Best Practices, contains expanded information and best practices for sUAS maintenance and inspection.

7.2 Maintenance. sUAS maintenance includes scheduled and unscheduled overhaul, repair, inspection, modification, replacement, and system software upgrades of the sUAS and its components necessary for flight. Whenever possible, the operator should maintain the sUAS and its components in accordance with manufacturer's instructions. The aircraft manufacturer may provide the maintenance program, or, if one is not provided, the applicant may choose to develop one. See paragraph 7.3.5 for suggested benefits of recordkeeping.

7.2.1 Scheduled Maintenance. The sUAS manufacturer may provide documentation for scheduled maintenance of the entire UA and associated system equipment. There may be components of the sUAS that are identified by the manufacturer to undergo scheduled periodic maintenance or replacement based on time-in-service limits (such as flight hours, cycles, and/or the calendar-days). All manufacturer scheduled maintenance instructions should be followed in the interest of achieving the longest and safest service life of the sUAS.

7.2.1.1 If there are no scheduled maintenance instructions provided by the sUAS manufacturer or component manufacturer, the operator should establish a scheduled maintenance protocol. This could be done by documenting any repair, modification, overhaul, or replacement of a system component resulting from normal flight operations, and recording the time-in-service for that component at the time of the maintenance procedure. Over time, the operator should then be able to establish a reliable maintenance schedule for the sUAS and its components.

7.2.2 Unscheduled Maintenance. During the course of a preflight inspection, the remote PIC may discover that an sUAS component is in need of servicing (such as lubrication), repair, modification, overhaul, or replacement outside of the scheduled maintenance period as a result of normal flight operations or resulting from a mishap. In addition, the sUAS manufacturer or component manufacture may require an unscheduled system software update to correct a problem. In the event such a condition is found, the remote PIC should not conduct flight operations until the discrepancy is corrected.

7.2.3 Performing Maintenance. In some instances, the sUAS or component manufacturer may require certain maintenance tasks be performed by the manufacturer or by a person or facility (personnel) specified by the manufacturer. It is highly recommended that the maintenance be performed in accordance with the manufacturer's instructions. However, if the operator decides not to use the manufacturer or personnel recommended by the manufacturer and is unable to perform the required maintenance, the operator should

consider the expertise of maintenance personnel familiar with the specific sUAS and its components. In addition, though not required, the use of certificated maintenance providers are encouraged, which may include repair stations, holders of mechanic and repairman certificates, and persons working under the supervision of these mechanics and repairman.

7.2.3.1 If the operator or other maintenance personnel are unable to repair, modify, or overhaul an sUAS or component back to its safe operational specification, then it is advisable to replace the sUAS or component with one that is in a condition for safe operation. It is important that all required maintenance be completed before each flight, and preferably in accordance with the manufacturer's instructions or, in lieu of that, within known industry best practices.

7.3 Preflight Inspection. Before each flight, the remote PIC must inspect the sUAS to ensure that it is in a condition for safe operation, such as inspecting for equipment damage or malfunction(s). The preflight inspection should be conducted in accordance with the sUAS manufacturer's inspection procedures when available (usually found in the manufacturer's owner or maintenance manual) and/or an inspection procedure developed by the sUAS owner or operator.

7.3.1 Creating an Inspection Program. As an option, the sUAS owner or operator may wish to create an inspection program for their UAS. The person creating an inspection program for a specific sUAS may find sufficient details to assist in the development of a suitable inspection program tailored to a specific sUAS in a variety of industry programs.

7.3.2 Scalable Preflight Inspection. The preflight check as part of the inspection program should include an appropriate UAS preflight inspection that is scalable to the UAS, program, and operation to be performed prior to each flight. An appropriate preflight inspection should encompass the entire system in order to determine a continued condition for safe operation prior to flight.

7.3.3 Title 14 CFR Part 43 Appendix D Guidelines. Another option and best practice may include the applicable portions of part 43 appendix D as an inspection guideline correlating to the UA only. System-related equipment, such as, but not limited to, the CS, data link, payload, or support equipment, are not included in the list in appendix D. Therefore, these items should be included in a comprehensive inspection program for the UAS.

7.3.4 Preflight Inspection Items. Even if the sUAS manufacturer has a written preflight inspection procedure, it is recommended that the remote PIC ensure that the following inspection items are incorporated into the preflight inspection procedure required by part 107 to help the remote PIC determine that the sUAS is in a condition for safe operation. The preflight inspection should include a visual or functional check of the following items:

1. Visual condition inspection of the UAS components;
2. Airframe structure (including undercarriage), all flight control surfaces, and linkages;
3. Registration markings, for proper display and legibility;
4. Moveable control surface(s), including airframe attachment point(s);
5. Servo motor(s), including attachment point(s);
6. Propulsion system, including powerplant(s), propeller(s), rotor(s), ducted fan(s), etc.;
7. Verify all systems (e.g., aircraft and control unit) have an adequate energy supply for the intended operation and are functioning properly;
8. Avionics, including control link transceiver, communication/navigation equipment, and antenna(s);
9. Calibrate UAS compass prior to any flight;
10. Control link transceiver, communication/navigation data link transceiver, and antenna(s);
11. Display panel, if used, is functioning properly;
12. Check ground support equipment, including takeoff and landing systems, for proper operation;
13. Check that control link correct functionality is established between the aircraft and the CS;
14. Check for correct movement of control surfaces using the CS;
15. Check onboard navigation and communication data links;
16. Check flight termination system, if installed;
17. Check fuel for correct type and quantity;
18. Check battery levels for the aircraft and CS;
19. Check that any equipment, such as a camera, is securely attached;
20. Verify communication with UAS and that the UAS has acquired GPS location from at least four satellites;
21. Start the UAS propellers to inspect for any imbalance or irregular operation;
22. Verify all controller operation for heading and altitude;
23. If required by flight path walk through, verify any noted obstructions that may interfere with the UAS; and
24. At a controlled low altitude, fly within range of any interference and recheck all controls and stability.

7.3.5 Benefits of Recordkeeping. sUAS owners and operators may find recordkeeping to be beneficial. This could be done by documenting any repair, modification, overhaul, or replacement of a system component resulting from normal flight operations, and recording the time-in-service for that component at the time of the maintenance procedure. Over time, the operator should then be able to establish a reliable maintenance schedule for the sUAS and its components. Recordkeeping that includes a record of all periodic inspections, maintenance, preventative maintenance, repairs, and alterations performed on the sUAS could be retrievable from either hardcopy and/or electronic logbook format for future reference. This includes all components of the sUAS, including: small UA, CS, launch and recovery equipment, C2 link equipment, payload, and any other components required to safely operate the sUAS. Recordkeeping of documented maintenance and inspection events reinforces owner/operator responsibilities for airworthiness through systematic condition for safe flight determinations. Maintenance and inspection recordkeeping provides retrievable empirical evidence of vital safety assessment data defining the condition of safety-critical systems and components supporting the decision to launch. Recordkeeping of an sUAS may provide essential safety support for commercial operators that may experience rapidly accumulated flight operational hours/cycles. Methodical maintenance and inspection data collection can prove to be very helpful in the tracking of sUAS component service life, as well as systemic component, equipage, and structural failure events.

APPENDIX A. RISK ASSESSMENT TOOLS

A.1 Purpose of this Appendix. The information in this appendix is a presentation of aeronautical decision-making (ADM), Crew Resource Management (CRM), and an example of a viable risk assessment process. This process is used to identify hazards and classify the potential risk that those hazards could present in an operation. It also provides examples of potential criteria for the severity of consequences and likelihood of occurrence that may be used by an sUAS remote pilot in command (PIC).

A.2 Aeronautical Decision-Making (ADM). The ADM process addresses all aspects of decisionmaking in a solo or crew environment and identifies the steps involved in good decisionmaking. These steps for good decisionmaking are as follows:

A.2.1 Identifying Personal Attitudes Hazardous to Safe Flight. Hazardous attitudes can affect unmanned operations if the remote PIC is not aware of the hazards, leading to such things as: getting behind the aircraft/situation, operating without adequate fuel/battery reserve, loss of positional or situational awareness, operating outside the envelope, and failure to complete all flight planning tasks, preflight inspections, and checklists. Operational pressure is a contributor to becoming subject to these pit-falls.

A.2.2 Learning Behavior Modification Techniques. Continuing to utilize risk assessment procedures for the operation will assist in identifying risk associated with the operation. Conducting an attitude assessment will identify situations where a hazardous attitude may be present.

A.2.3 Learning How to Recognize and Cope with Stress. Stress is ever present in our lives and you may already be familiar with situations that create stress in aviation. However, UAS operations may create stressors that differ from manned aviation. Such examples may include: working with an inexperienced crewmember, lack of standard crewmember training, interacting with the public and city officials, and understanding new regulatory requirements. Proper planning for the operation can reduce or eliminate stress, allowing you to focus more clearly on the operation.

A.2.4 Developing Risk Assessment Skills. As with any aviation operation, identifying associated hazards is the first step. Analyzing the likelihood and severity of the hazards occurring establishes the probability of risk. In most cases, steps can be taken to mitigate, even eliminate, those risks. Actions such as using visual observers (VO), completing a thorough preflight inspection, planning for weather, familiarity with the airspace, proper aircraft loading, and performance planning can mitigate identified risks. Figure A-1, Hazard Identification and Risk Assessment Process Chart, is an example of a risk assessment tool. Others are also available for use.

A.2.5 Using All Available Resources with More Than One Crewmember (CRM). A characteristic of CRM is creating an environment where open communication is encouraged and expected, and involves the entire crew to maximize team performance. Many of the same resources that are available to manned aircraft operations are available to UAS operations. For example, remote PICs can take advantage of traditional CRM

techniques by utilizing additional crewmembers, such as VOs and other ground crew. These crewmembers can provide information about traffic, airspace, weather, equipment, and aircraft loading and performance. Examples of good CRM include:

A.2.5.1 **Communication Procedures**. One way to accomplish this is to have the VO maintain visual contact with the small UA and maintain awareness of the surrounding airspace, and then communicate flight status and any hazards to the remote PIC and person manipulating the controls so that appropriate action can be taken. Then, as conditions change, the remote PIC should brief the crew on the changes and any needed adjustments to ensure a safe outcome of the operation.

A.2.5.2 **Communication Methods**. The remote PIC, person manipulating the controls, and VO must work out a method of communication, such as the use of a hand-held radio or other effective means, that would not create a distraction and allows them to understand each other. The remote PIC should evaluate which method is most appropriate for the operation and should be determined prior to flight.

A.2.5.3 **Task Management.** Tasks very depending on the complexity of the operation. Depending upon the area of the operations, additional crewmembers may be needed to safely operate. Enough crewmembers should be utilized to ensure no one on the team becomes overloaded. Once a member of the team becomes over worked, there's a greater possibility of an incident/accident.

A.2.5.4 **Other Resources**. Take advantage of information from a weather briefing, air traffic control (ATC), the FAA, local pilots, and landowners. Technology can aid in decisionmaking and improve situational awareness. Being able to collect the information from these resources and manage the information is key to situational awareness and could have a positive effect on your decisionmaking.

A.2.6 Evaluating the Effectiveness of One's ADM Skills. Successful decisionmaking is measured by a pilot's consistent ability to keep himself or herself, any persons involved in the operation, and the aircraft in good condition regardless of the conditions of any given flight. As with manned operations, complacency and overconfidence can be risks, and so there are several checklists and models to assist in the decisionmaking process. Use the IMSAFE checklist to ensure you are mentally and physically prepared for the flight. Use the DECIDE model to help you continually evaluate each operation for hazards and analyze risk. Paragraph A.5.5 and the current edition of AC 60-22, Aeronautical Decision Making, can provide additional information on these models and others.

A.3 **Hazard Identification.** Hazards in the sUAS and its operating environment must be identified, documented, and controlled. The analysis process used to define hazards needs to consider all components of the system, based on the equipment being used and the

environment it is being operated in. The key question to ask during analysis of the sUAS and its operation is, "*what if?*" sUAS remote PICs are expected to exercise due diligence in identifying significant and reasonably foreseeable hazards related to their operations.

Figure A-1. Hazard Identification and Risk Assessment Process Chart

A.4 Risk Analysis and Assessment. The risk assessment should use a conventional breakdown of risk by its two components: likelihood of occurrence and severity.

A.5 Severity and Likelihood Criteria. There are several tools which could be utilized in determining severity and likelihood when evaluating a hazard. One tool is a risk matrix. Several examples of these are presented in Figure A-2, Safety Risk Matrix Examples. The definitions and construction of the matrix is left to the sUAS remote PIC to design. The definitions of each level of severity and likelihood need to be defined in terms that are realistic for the operational environment. This ensures each remote PIC's decision tools are relevant to their operations and operational environment, recognizing the extensive diversity which exists. An example of severity and likelihood definitions is shown in Table A-1, Sample Severity and Likelihood Criteria.

Table A-1. Sample Severity and Likelihood Criteria

Severity of Consequences			**Likelihood of Occurrence**		
Severity Level	Definition	Value	Likelihood Level	Definition	Value
Catastrophic	Equipment destroyed, multiple deaths.	5	Frequent	Likely to occur many times	5
Hazardous	Large reduction in safety margins, physical distress, or a workload such that crewmembers cannot be relied upon to perform their tasks accurately or completely. Serious injury or death. Major equipment damage.	4	Occasional	Likely to occur sometimes	4
Major	Significant reduction in safety margins, reduction in the ability of crewmembers to cope with adverse operating conditions as a result of an increase in workload, or as result of conditions impairing their efficiency. Serious incident. Injury to persons.	3	Remote	Unlikely, but possible to occur	3
Minor	Nuisance. Operating limitations. Use of emergency procedures. Minor incident.	2	Improbable	Very unlikely to occur	2
Negligible	Little consequence.	1	Extremely Improbable	Almost inconceivable that the event will occur	1

A.5.1 Risk Acceptance. In the development of risk assessment criteria, sUAS remote PICs are expected to develop risk acceptance procedures, including acceptance criteria and designation of authority and responsibility for risk management decisionmaking. The acceptability of risk can be evaluated using a risk matrix, such as those illustrated in Figure A-2. Table A-2, Safety Risk Matrix—Example shows three areas of acceptability.

Risk matrices may be color coded; unacceptable (red), acceptable (green), and acceptable with mitigation (yellow).

A.5.1.1 Unacceptable (Red). Where combinations of severity and likelihood cause risk to fall into the red area, the risk would be assessed as unacceptable and further work would be required to design an intervention to eliminate that associated hazard or to control the factors that lead to higher risk likelihood or severity.

A.5.1.2 Acceptable (Green). Where the assessed risk falls into the green area, it may be accepted without further action. The objective in risk management should always be to reduce risk to as low as practicable regardless of whether or not the assessment shows that it can be accepted as is.

A.5.1.3 Acceptable with Mitigation (Yellow). Where the risk assessment falls into the yellow area, the risk may be accepted under defined conditions of mitigation. An example of this situation would be an assessment of the impact of an sUAS operation near a school yard. Scheduling the operation to take place when school is not in session could be one mitigation to prevent undue risk to the children that study and play there. Another mitigation could be restricting people from the area of operations by placing cones or security personnel to prevent unauthorized access during the sUAS flight operation.

Figure A-2. Safety Risk Matrix Examples

Table A-2. Safety Risk Matrix—Example

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

Note: The direction of higher/lower and more/less scales on a matrix is at the discretion of the remote PIC.

A.5.2 Other Risk Assessment Tools for Flight and Operational Risk Management. Other tools can also be used for flight or operational risk assessments and can be developed by the remote PICs themselves. The key thing is to ensure that all potential hazards and risks are identified and appropriate actions are taken to reduce the risk to persons and property not associated with the operations.

A.5.3 Reducing Risk. Risk analyses should concentrate not only on assigning levels of severity and likelihood, but on determining why these particular levels were selected. This is referred to as *root cause analysis*, and is the first step in developing effective controls to reduce risk to lower levels. In many cases, simple brainstorming sessions among crewmembers is the most effective and affordable method of finding ways to reduce risk. This also has the advantage of involving people who will ultimately be required to implement the controls developed.

A.5.3.1 It is also very easy to get quite bogged down in trying to identify all hazards and risks. That is not the purpose of a risk assessment. The focus should be upon those hazards which pose the greatest risks. As stated earlier, by documenting and compiling these processes, a remote PIC can build an arsenal of safety practices that will add to the safety and success of future operations.

A.5.4 Sample Hazard Identification and Risk Assessment.

A.5.4.1 **Example.** I am the remote PIC of an sUAS in the proximity of an accident scene shooting aerial footage. Much like pilots in manned aircraft must adhere to preflight action (part 91, § 91.103), I must adhere to preflight familiarization, inspection, and aircraft operations (§ 107.49). Let's say that there is an obvious takeoff and landing site that I intend to use. What if, while I am operating a manned aircraft (emergency medical services (EMS) helicopter) requires use of the same area and I am not left with a suitable landing site? Furthermore, I am running low on power. If I consider this situation prior to flight, I can use the Basic Hazard Identification and Mitigation Process. Through this process, I might determine that an acceptable level of risk can be achieved by also having an alternate landing site and possibly additional sites at which I can sacrifice the UA to avoid imposing risk to people on the ground or to manned aircraft operations. It is really a simple process: I must consider the hazards presented during this particular operation, determine the risk severity, and then develop a plan to lessen (or mitigate) the risk to an acceptable level. By documenting and compiling these processes, I can build an arsenal of safety practices that will add to the safety and success of future operations. The following are some proven methods that can help a new remote PIC along the way:

A.5.4.2 **Hazard Identification.** Using the Personal Minimums (PAVE) Checklist for Risk Management, I will set personal minimums based upon my specific flight experience, health habits, and tolerance for stress, just to name a few. After identifying hazards, I will then input them into the Hazard Identification and Risk Management Process Chart (Figure A-1).

1. **P**ersonal: Am I healthy for flight and what are my personal minimums based upon my experience operating this sUAS? During this step, I will often use the IMSAFE checklist in order to perform a more in-depth evaluation:
   - **I**llness – Am I suffering from any illness or symptom of an illness which might affect me in flight?
   - **M**edication – Am I currently taking any drugs (prescription or over-the-counter)?
   - **S**tress – Am I experiencing any psychological or emotional factors which might affect my performance?
   - **A**lcohol – Have I consumed alcohol within the last 8 to 24 hours?
   - **F**atigue – Have I received sufficient sleep and rest in the recent past?
   - **E**ating – Am I sufficiently nourished?
2. **A**ircraft: Have I conducted a preflight check of my sUAS (aircraft, control station (CS), takeoff and landing equipment, etc.) and

determined it to be in a condition for safe operation? Is the filming equipment properly secured to the aircraft prior to flight?

3. En**V**iroment: What is the weather like? Am I comfortable and experienced enough to fly in the forecast weather conditions? Have I considered all of my options and left myself an "out?" Have I determined alternative landing spots in case of an emergency?

4. **E**xternal Pressures: Am I stressed or anxious? Is this a flight that will cause me to be stressed or anxious? Is there pressure to complete the flight operation quickly? Am I dealing with an unhealthy safety culture? Am I being honest with myself and others about my personal operational abilities and limitations?

A.5.5 Controlling Risk. After hazards and risks are fully understood through the preceding steps, risk controls must be designed and implemented. These may be additional or changed procedures, additional or modified equipment, the addition of VOs, or any of a number of other changes.

A.5.6 Residual and Substitute Risk. Residual risk is the risk remaining after mitigation has been completed. Often, this is a multistep process, continuing until risk has been mitigated down to an acceptable level necessary to begin or continue operation. After these controls are designed but before the operation begins or continues, an assessment must be made of whether the controls are likely to be effective and/or if they introduce new hazards to the operation. The latter condition, introduction of new hazards, is referred to as substitute risk, a situation where the cure is worse than the disease. The loop seen in Figure A-1 that returns back to the top of the diagram depicts the use of the preceding hazard identification, risk analysis, and risk assessment processes to determine if the modified operation is acceptable.

A.5.7 Starting the Operation. Once appropriate risk controls are developed and implemented, then the operation can begin.

APPENDIX B. SUPPLEMENTAL OPERATIONAL INFORMATION

B.1 Determining Operational Performance. The manufacturer may provide operational and performance information that contains the operational performance data for the aircraft such as data pertaining to takeoff, climb, range, endurance, descent, and landing. To be able to make practical use of the aircraft's capabilities and limitations, it is essential to understand the significance of the operational data. The use of this data in flying operations is essential for safe and efficient operation. It should be emphasized that the manufacturers' information regarding performance data is not standardized. If manufacturer-published performance data is unavailable, it is advisable to seek out performance data that may have already been determined and published by other users of the same sUAS manufacturer model and use that data as a starting point.

B.2 sUAS Loading and Its Effects on Performance.

1. **Weight and Balance (W&B).** Before any flight, the remote PIC should verify the aircraft is correctly loaded by determining the W&B condition of the aircraft. An aircraft's W&B restrictions established by the manufacturer or the builder should be closely followed. Compliance with the manufacturer's W&B limits is critical to flight safety. The remote PIC must consider the consequences of an overweight aircraft if an emergency condition arises.

   - Although a maximum gross takeoff weight may be specified, the aircraft may not always safely take off with this load under all conditions. Conditions that affect takeoff and climb performance, such as high elevations, high air temperatures, and high humidity (high density altitudes) may require a reduction in weight before flight is attempted. Other factors to consider prior to takeoff are runway/launch area length, surface, slope, surface wind, and the presence of obstacles. These factors may require a reduction in weight prior to flight.

   - Weight changes during flight also have a direct effect on aircraft performance. Fuel burn is the most common weight change that takes place during flight. As fuel is used, the aircraft becomes lighter and performance is improved, but this could have a negative effect on balance. In UAS operations, weight change during flight may occur when expendable items are used on board (e.g., a jettisonable load).

2. **Balance, Stability, and Center of Gravity (CG).** Adverse balance conditions (i.e., weight distribution) may affect flight characteristics in much the same manner as those mentioned for an excess weight condition. Limits for the location of the CG may be established by the manufacturer. The CG is not a fixed point marked on the aircraft; its location depends on the distribution of aircraft weight. As variable load items are shifted or expended, there may be a resultant shift in CG location. The remote PIC should determine how the CG will shift and the resultant effects on the aircraft. If the CG is not within the allowable limits after loading or do not remain within the allowable limits for safe flight, it will be necessary to relocate or shed some weight before flight is attempted.

B.3 Sources of Weather Information for Small UA Operations. Remote PICs are encouraged to obtain weather information prior to flight from Flight Service by using the Web site www.1800wxbrief.com. Remote PICs can create a free account in order to use the briefing service. While Flight Service does offer a telephone-based service, it is intended for manned aircraft pilots only.

B.3.1 National Weather Service (NWS). Remote PICs are also encouraged to visit the NWS's Aviation Weather Center (AWC) at www.aviationweather.gov. This free, Web-based service does not require registration and offers all of the weather products important to a remote PIC, such as Aviation Routine Weather Reports (METAR) and Terminal Aerodrome Forecast (TAF). While reviewing the weather for your intended operation, it is also critical that the remote PIC review any temporary flight restrictions (TFR) at the FAA's TFR Web site, which can be found at http://tfr.faa.gov.

B.4 Weather and the Effects on Performance. Weather is an important factor that influences aircraft performance and flying safety. Atmospheric pressure and density, wind, and uneven surface heating are factors that affect sUAS performance and must be considered prior to flight.

B.4.1 Wind. Wind speed and direction are important as they affect takeoff, landing, and cruise of flight operations. Geological features, trees, structures, and other anomalies can affect the wind direction and speed close to the ground. In particular, ground topography, trees, and buildings can break up the flow of the wind and create wind gusts that change rapidly in direction and speed. The remote PIC should be vigilant when operating UAS near large buildings or other man-made structures and natural obstructions, such as mountains, bluffs, or canyons. The intensity of the turbulence associated with ground obstructions depends on the size of the obstacle and the primary velocity of the wind. This same condition is even more noticeable when flying in mountainous regions. While the wind flows smoothly up the windward side of the mountain and the upward currents help to carry an aircraft over the peak of the mountain, the wind on the leeward side does not act in a similar manner. As the air flows down the leeward side of the mountain, the air follows the contour of the terrain and is increasingly turbulent. This tends to push an aircraft into the side of a mountain. The stronger the wind, the greater the downward pressure and turbulence become. Due to the effect terrain has on the wind in valleys or canyons, downdrafts can be severe.

B.4.2 Surface Heat. Different surfaces radiate heat in varying amounts. Plowed ground, rocks, sand, and barren land give off a larger amount of heat, whereas water, trees, and other areas of vegetation tend to absorb and retain heat. The resulting uneven heating of the air creates small areas of local circulation called convective currents, which creates bumpy, turbulent air. Convective currents, with their rising and sinking air can adversely affect the controllability of the small UA.

B.5 Battery Fires. Lithium-based batteries are highly flammable and capable of ignition. A battery fire could cause an in-flight emergency by causing a LOC of the small UA. Lithium battery fires can be caused when a battery short circuits, is improperly charged, is heated to extreme temperatures, is damaged as a result of a crash, is mishandled, or is

simply defective. The remote PIC should consider following the manufacturer's recommendations, when available, to help ensure safe battery handling and usage.

B.6 sUAS Frequency Utilization. An sUAS typically uses radio frequencies (RF) for the communication link between the CS and the small UA.

1. **Frequency spectrum (RF) Basics.** The 2.4 GHz and 5.8 GHz systems are the unlicensed band RFs that most sUAS use for the connection between the CS and the small UA. Note the frequencies are also used for computer wireless networks and the interference can cause problems when operating a UA in an area (e.g., dense housing and office buildings) that has many wireless signals. LOC and flyaways are some of the reported problems with sUAS frequency implications.

    - To avoid frequency interference, many modern sUAS operate using a 5.8 GHz system to control the small UA and a 2.4 GHz system to transmit video and photos to the ground. Consult the sUAS operating manual and manufacturers recommended procedures before conducting sUAS operations.

    - It should be noted that both RF bands (2.4 GHz and 5.8 GHz) are considered line of sight and the command and control link between the CS and the small UA will not work properly when barriers are between the CS and the UA. Part 107 requires the remote PIC or person manipulating the controls to be able to see the UA at all times, which should also help prevent obstructions from interfering with the line of sight frequency spectrum.

2. **Spectrum Authorization.** Frequency spectrum used for small UA operations are regulated by the Federal Communications Commission (FCC). Radio transmissions, such as those used to control a UA and to downlink real-time video, must use frequency bands that are approved for use by the operating agency. The FCC authorizes civil operations. Some operating frequencies are unlicensed and can be used freely (e.g., 900 MHz, 2.4 GHz, and 5.8 GHz) without FCC approval. All other frequencies require a user-specific license for all civil users, except federal agencies, to be obtained from the FCC. For further information, visit https://www.fcc.gov/licensing-databases/licensing.

APPENDIX C. sUAS MAINTENANCE AND INSPECTION BEST PRACTICES

C.1 In the interest of assisting varying background levels of sUAS knowledge and skill, below is a chart offering conditions that, if noticed during a preflight inspection or check, may support a determination that the UAS is not in a condition for safe operation. Further inspection to identify the scope of damage and extent of possible repair needed to remedy the unsafe condition may be necessary prior to flight.

Table C-1. sUAS Condition Chart

Conditions that may be found may include, but are not limited to, the following:

Condition	Action
1. Structural or skin cracking	Further inspect to determine scope of damage and existence of possible hidden damage that may compromise structural integrity. Assess the need and extent of repairs that may be needed for continued safe flight operations.
2. Delamination of bonded surfaces	Further inspect to determine scope of damage and existence of possible hidden damage that may compromise structural integrity. Assess the need and extent of repairs that may be needed for continued safe flight operations.
3. Liquid or gel leakage	Further inspect to determine source of the leakage. This condition may pose a risk of fire resulting in extreme heat negatively impacting aircraft structures, aircraft performance characteristics, and flight duration. Assess the need and extent of repairs that may be needed for continued safe flight operations.
4. Strong fuel smell	Further inspect to determine source of the smell. Leakage exiting the aircraft may be present and/or accumulating within a sealed compartment. This condition may pose a risk of fire resulting in extreme heat negatively impacting aircraft structures, aircraft performance characteristics, and flight duration. Assess the need and extent of repairs that may be needed for continued safe flight operations.
5. Smell of electrical burning or arcing	Further inspect to determine source of the possible electrical malfunction. An electrical hazard may pose a risk of fire or extreme heat negatively impacting aircraft structures,

	aircraft performance characteristics, and flight duration. Assess the need and extent of repairs that may be needed for continued safe flight operations.
6. Visual indications of electrical burning or arcing (black soot tracings, sparking)	Further inspect to determine source of the possible electrical malfunction. An electrical hazard may pose a risk of fire or extreme heat negatively impacting aircraft structures, aircraft performance characteristics, and flight duration. Assess the need and extent of repairs that may be needed for continued safe flight operations.
7. Noticeable sound (decibel) change during operation by the propulsion system	Further inspect entire aircraft with emphasis on the propulsion system components (i.e., motors and propellers) for damage and/or diminished performance. Assess the need and extent of repairs that may be needed for continued safe flight operations.
8. Control inputs not synchronized or delayed	Discontinue flight and/or avoid further flight operations until further inspection and testing of the control link between the ground control unit and the aircraft. Ensure accurate control communications are established and reliable prior to further flight to circumvent possible loss of control resulting in the risk of a collision or flyaway. Assess the need and extent of repairs that may be needed for continued safe flight operations.
9. Battery casing distorted (bulging)	Further inspect to determine integrity of the battery as a reliable power source. Distorted battery casings may indicate impending failure resulting in abrupt power loss and/or explosion. An electrical hazard may be present, posing a risk of fire or extreme heat negatively impacting aircraft structures, aircraft performance characteristics, and flight duration. Assess the need and extent of repairs that may be needed for continued safe flight operations.
10. Diminishing flight time capability (electric powered propulsion systems)	Further inspect to determine integrity of the battery as a reliable power source. Diminishing battery capacity may indicate impending failure due to exhausted service life, internal, or external damage. An electrical hazard may

	be present, posing a risk of fire or extreme heat negatively impacting aircraft structures, aircraft performance characteristics, and flight duration. Assess the need and extent of repairs that may be needed for continued safe flight operations.
11. Loose or missing hardware/fasteners	Further inspect to determine structural integrity of the aircraft and/or components with loose or missing hardware/fasteners. Loose or missing hardware/fasteners may pose a risk of negatively impacting flight characteristics, structural failure of the aircraft, dropped objects, loss of the aircraft, and risk to persons and property on the grounds. For continued safe flight operations, secure loose hardware/fasteners. Replace loose hardware/fasteners that cannot be secured. Replace missing hardware/fasteners.

Advisory Circular Feedback Form

If you find an error in this AC, have recommendations for improving it, or have suggestions for new items/subjects to be added, you may let us know by contacting the General Aviation and Commercial Division (AFS-800) at 9-AFS-800-Correspondence@faa.gov or the Flight Standards Directives Management Officer.

Subject: AC 107-SMALL, Small Unmanned Aircraft Systems (sUAS)

Date: _____

Please check all appropriate line items:

☐ An error (procedural or typographical) has been noted in paragraph _____ on page_____.

☐ Recommend paragraph_____on page_____be changed as follows:

_____

_____

☐ In a future change to this AC, please cover the following subject:
(Briefly describe what you want added.)

_____

_____

☐ Other comments:

_____

_____

☐ I would like to discuss the above. Please contact me.

Submitted by:_____ Date: _____