THE COMPLETE
REMOTE PILOT

SECOND EDITION

Bob Gardner and David Ison

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Second Edition
by Bob Gardner and David Ison

Aviation Supplies & Academics, Inc.
7005 132nd Place SE
Newcastle, Washington 98059
asa@asa2fly.com | 425-235-1500 | asa2fly.com

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Foreword

I have always loved stuff that is up in the air. When I was a child, my father was also a big fan, so we went to air shows, flew model airplanes, and would pull over and stop alongside the road in our rural area to watch big Stearmans spraying the farm ground. My fascination with model airplanes never left, and many years later I find myself making a living out of my hobby. If you're considering the same, this publication is for you.

You can fly sUAS (small uncrewed aircraft systems) platforms professionally, but there are required steps you must take and information you have to know. In fact, you have to become an aviator. The lines between a UAV (uncrewed air vehicle) flight and a piloted aircraft are really becoming blurred. To fly an sUAS, you will need to understand weather, the National Airspace System, airport operations, and other items previously held for crewed aircraft. One of the largest tasks ahead will be learning a new language. Aviation has its own terminology, and to make it even more challenging, so much of it is referred to with acronyms. Authors Bob Gardner and David Ison have laid all of this out for you, organized it well for future reference, and included great graphics.

I remember watching an entire battalion surrender to a drone on the nightly news in late 1990 and thinking that all of those bad guys threw their hands up to a model airplane. Well, sort of…. The connection is real, and it's been very gratifying to see so many drone pilots for the military come out of the model airplane ranks. Today, the technology of multi-rotors and their built-in stabilization allow flying by many more operators with fewer "stick and rudder" skills. This knowledge, however, is still a major part of being an aviator. David Ison and Bob Gardner have written a great flight plan to obtain all of the aviation knowledge required for becoming "The Complete Remote Pilot."

Enjoy your flight!

Bill Pritchett
Director of Education
Academy of Model Aeronautics

About the Authors

Bob Gardner

Robert Gardner began his flying career in Alaska in 1960 while in the U.S. Coast Guard. By 1966, Bob earned his Private Land and Sea, Commercial, Instrument, Instructor, CFII and MEL. Over the next 16 years, he was an instructor, charter pilot, designated examiner, corporate and freight captain, and director of ASA Ground Schools.

Bob held an Airline Transport Pilot Certificate with Single-Engine and Multi-Engine Land ratings; a CFI certificate with Instrument and Multi-Engine ratings; and a Ground Instructor's Certificate with Advanced and Instrument ratings. In addition, Bob was a Gold Seal Flight Instructor and was recognized as a Flight Instructor of the Year in Washington State. To top off this impressive list of accomplishments, Bob was also a well-known author, journalist, airshow lecturer and long-admired member of the aviation community.

David Ison

Industry expert David C. Ison, Ph.D., has been involved in aviation for more than 35 years, during which he has flown as a flight instructor and as an ATP for both regional and major airlines flying domestic and international routes. He holds ATP Multi-Engine Land, Commercial Single-Engine Land and Sea, Gold Seal Certified Flight Instructor, Instrument Flight Instructor, Multi-Engine Flight Instructor, Ground Instructor—Instrument and Advanced, Remote Pilot, and Aircraft Dispatcher certifications.

Dr. Ison has been in aviation higher education for more than 15 years and currently holds the position of Professor, Graduate School, at Northcentral University. He graduated with a Bachelor of Science in Aviation Management from Auburn University, a Master of Science in Aeronautical Science–Operations Specialization from Embry-Riddle Aeronautical University, and a Ph.D. in Educational Studies/Higher Education Leadership with a specialization in Aviation Education from the University of Nebraska–Lincoln.

Getting Started

INTRODUCTION

by David Ison and Bob Gardner

It is hard not to want to explore the possibilities of becoming a drone pilot. Drones, officially referred to as uncrewed or unmanned aircraft systems (UAS), provide tremendous opportunities for commercial and personal use. They provide a unique view of our world, are relatively simple to use, and have become increasingly affordable. While UAS have often been viewed as toys, they have become very sophisticated vehicles capable of performing a range of tasks. This increase in capabilities and utilities has resulted in more common use of UAS, with them oftentimes sharing airspace with crewed aircraft. Thus it is necessary for UAS operators, or remote pilots, to be aware of the various requirements, regulations, and operational principles associated with crewed aircraft so as to safely and responsibly operate in the airspace above the United States (referred to as the National Airspace System or NAS).

For many of you, this may be the first time you have been exposed to the sometimes confusing and complex nature of aviation and piloting knowledge. Even if you are a crewed aircraft pilot, you may be unfamiliar with the intricacies associated with UAS operations and how they fit in with crewed aircraft. Reading this book is your first step in the path to become a competent, knowledgeable, responsible, and safe remote pilot as well as prepare for the Federal Aviation Administration (FAA) written knowledge test.

The first step is to collect some information that is readily available from the FAA. Since UAS operations are covered by FAA regulations, it is a good idea to get your hands on a copy of these important documents. Since these rules have been fairly dynamic, I would suggest you visit the Electronic Code of Federal Regulations website (eCFR) at ecfr.gov and peruse Title 14, which covers everything aviation-related. In particular, you will want to read through 14 CFR Parts 91 and 107. Part 91 covers general operations requirements for aircraft and pilots, while Part 107 is specific to UAS. It is also recommended that you read FAA Advisory Circular (AC) 107-2A, *Small Unmanned Aircraft System (Small UAS)*, which expands upon the various requirements for sUAS operations in the United States.

For those of you who are seeking to fly only recreationally, you technically do not need a Remote Pilot certificate, but it is wise to familiarize yourself with the aforementioned information. Additionally, you will want to get a copy of FAA Advisory Circular 91-57B, *Exception for Limited Recreational Operations of Unmanned Aircraft*. You may also want to join the Academy of Model Aeronautics (AMA), which provides tremendous resources for hobbyist pilots.

While the FAA provides some free online training and documents for aspiring remote pilots (including those who already hold a crewed pilot certificate), a more comprehensive reference is necessary to fully understand UAS and how to safely use them in U.S. airspace. Thus, this book was written to help guide you through the process of becoming an educated, responsible, and safe remote pilot.

Note: The FAA and aviation community are in the process of transitioning from use of the terms *manned* and *unmanned* to *crewed* and *uncrewed*. Many FAA regulations and documents still use the former, and these terms are used interchangeably throughout this book, but you can expect to see increasing use of *crewed* and *uncrewed* over time.

REMOTE PILOT CERTIFICATE

There are two primary pathways to becoming a certificated Remote Pilot. First, if you are not a current crewed aircraft pilot (e.g., Private Pilot, Commercial Pilot, or ATP with a current flight review), you will need to successfully pass the FAA Remote Pilot knowledge exam. (Note that a Student Pilot certificate does not suffice.) This exam covers a range of topics, many of which are likely to be unfamiliar to both crewed and uncrewed aircraft pilots. Therefore, you will need to do some studying before attempting the exam. Studying is critical to success. At a cost upwards of $175 for each attempt, you do not want to have to take the exam more than once; moreover, the FAA requires you to wait 14 days to retest if you fail. In order to take the Remote Pilot exam, you must be at least 16 years of age, and you must receive a score of at least 70 percent to pass. Prior to taking the exam, you should create an Integrated Airman Certification and Rating Application (IACRA) account by visiting iacra.faa.gov. After passing the exam, you will complete your IACRA application for the Remote Pilot certificate with an sUAS rating. A temporary certificate, good for 120 days, will be issued. Once your application has been officially processed, you will receive a permanent certificate in the mail.

The second pathway applies to certificated crewed aircraft pilots (excluding Student Pilots) who are current per 14 CFR §61.56. Additionally, you will need to complete the FAA's online Part 107 training course which, upon completion, will provide you with a certificate as evidence of the achievement. You will then need to apply via a Flight Standards District Office (FSDO), designated pilot examiner, airman certification representative, certificated flight instructor, or other person authorized by the FAA administrator. You will be issued a temporary certificate that is valid for 120 days, after which you will receive a permanent certificate in the mail.

WHAT WILL THIS BOOK DO FOR YOU?

A quick search of the Internet and popular online retailers will display almost endless numbers of resources to study for the Remote Pilot exam and to prepare for flying UAS recreationally or for business. Unfortunately, most miss many of the nuances associated with aeronautical knowledge and often simply regurgitate, in overly terse text or outline form, what the FAA has released. These resources don't provide the most efficacious or efficient way to become a competent remote pilot. This text is designed to not only prepare you for the exam, but also to help you learn how UAS fly, how to intelligently talk about them and their components, and to be well-versed in the aeronautical knowledge required to fly these systems in the same airspace as large commercial jets.

Our goal is to provide important details in down-to-earth language. Whether or not you already know a thing or two about flying, this book will bring things into perspective specifically for the remote pilot. Aviation has its own language, much of which remote pilots need to know to understand the intricacies associated with flying. Sometimes the terms, maps, and reports available to the crewed aircraft world are somewhat complex and confusing. That's what this book is for—to guide you through this unfamiliar territory (or refresh your memory about it) so you never have to feel lost.

Here are some examples of things you need to know, but may not yet be prepared to perform:

- Did you know that you should not typically fly UAS within 5 nautical miles of an airport with a control tower?
- How do you know you're within 5 nautical miles?
- What is a nautical mile?
- How do you know if an airport has a control tower?

These are just a few examples of questions you will be able to answer with the help of this book. And this is just one tiny bit of aviation knowledge from the plethora of information with which you must be familiar. Fear not, however, because we'll guide you through it all. Best of all, each lesson has review questions to ensure you understand the material, as well as to help prepare you for your written exam. You may also want to purchase ASA's *Remote Pilot Test Prep* book to focus in on the exam itself, and additional information and updates relating to this book are available on the reader resources webpage at asa2fly.com/reader/rpt.

Well, let's get started!

LESSON 1

Uncrewed Aircraft Systems: Learning the Language of Drones

A VERY BRIEF HISTORY OF UNCREWED AIRCRAFT SYSTEMS (UAS)

Here is a question to get us started: when was the first drone (which we will refer to as UAS) flown? What's your guess? Would you believe that it was in August of 1849? While the Austrians were laying siege to the city of Venice, Italy, they concocted a plan to send balloons with attached explosives to bombard the city. While one could argue that these were not UAS as we imagine them, they were one of the first uses of an aerial system to complete a mission of sorts. Similar tactics were employed during the U.S. Civil War but were not entirely effective. In 1896, Samuel Langley launched an uncrewed aircraft, the Aerodrome, off of a catapult housed on his floating barge. It wasn't until World War I that a guided, pilotless winged aircraft was flown. Between 1916 and 1917, the first of these types of aircraft were flown—some to serve as targets and others to deliver bombs, the latter which were referred to as aerial torpedoes, guided by rudimentary autopilots.

World War II brought forth a slew of UAS from both Axis and Allied forces. Germany's V-1 "buzz bomb" had a simplistic guidance system that would cut the engine when assumed to be in the target area. The United States also experimented with remote control technologies to convert existing crewed aircraft into UAS. One example was Project Aphrodite, in which B-17 bombers were made into flying bombs. Pilots were on board to take off and to arm the warhead. After remote control was engaged, the pilots would parachute out. Probably the most prolific use of UAS during this period was as targets, with more than 12,000 target drones used to assist aerial gunners and pilots practice their shooting skills.

Most of the UAS activity from World War II to Vietnam continued to be in the form of target flights or flying bombs. Eventually, the latter evolved into the modern-day cruise missile. UAS were later used for reconnaissance, typically launched from an airborne platform such as a Lockheed C-130 Hercules. Following the Vietnam War, the United States dramatically slowed its drone research and production, but other countries, notably Israel, made leaps and bounds, paving the way for the UAS age as we know it.

Around 1990, the United States became increasingly interested in using UAS to perform missions that would typically be too boring or dangerous for crewed aircraft pilots. Thanks to the Global Positioning System (GPS) and advances in sensors, computational power, and other components, UAS could be accurately guided to precise target locations and perform a range of missions from reconnaissance to attack. By 1994, companies were producing uncrewed war machines. UAS such as the now-familiar Predator and Global Hawk came to fruition. Since 2000, the U.S. military has rapidly increased its use of UAS to perform tactical missions across the globe. Today, headlines frequently highlight the U.S. military's use of UAS. However, these types of UAS are not commonly seen in the United States (although they do fly here—for training, special missions, and border protection purposes), and they do not resemble the types of systems most remote pilots will operate.

While militaries were figuring out how to utilize UAS for war, radio-controlled aircraft as we know them today were concurrently being developed. In fact, the technologies went hand in hand. The ability to control an object via radio came about in 1898, thanks to Nikola Tesla. A more sophisticated control system was tested in 1903, using radio waves to execute specific commands on a robot. By 1917, such technologies were being used in UAS. Throughout the period of the World Wars, remote control aircraft became more sophisticated and popular. In the 1950s, gas- and battery-powered, remote control aircraft truly sparked the hobby flying market. By 1968, there were even remote-controlled helicopters. As batteries have improved, computers and other components have shrunk, and as prices of these items have become more reasonable, the world of remote control flying has become more accessible to a wider audience. While much of the remote control flying done before the early 2000s was for recreation or as a hobby, it quickly became apparent that UAS has much more capability and potential. Fast-forward to today, and UAS are technologically advanced tools that can be used to perform a very wide range of functions, from simple photography to assisting farmers through the use of precision agricultural sensors. There is no limit to what modern UAS can do. The only limit is your imagination. Of course, a UAS is only as good as its pilot, so let's start digging into the details on how to become one.

TERMS AND ABBREVIATIONS

Both the crewed and uncrewed aircraft worlds have their own set of terms and abbreviations. Wouldn't you be a little nervous if you asked a doctor, "Hey doc, what are the results of my thoracic CT scan?" and he looked at you puzzled, responding "A what kind of scan? What is a CT?" Similarly, you want to be able to use and understand the UAS/aviation talk. This is essential to being a knowledgeable remote pilot, but it can also be a critical part of communication with other UAS operators and personnel as well as conversations you may need to have with pilots and air traffic controllers.

Below are some of the most common UAS and aviation-related terms and abbreviations that will be important for you to know.

AC — Advisory Circular—an advisory document released by the FAA to provide additional guidance on important subjects that goes beyond the explanations in the regulations and other documents.

AGL — Above ground level—the height, in feet, of an object (e.g., tower or UAS) above the underlying local area terrain.

AIM — *Aeronautical Information Manual*—An FAA publication applicable to all types of aviation/aerospace operations. Provides detailed information on topics such as air traffic control, weather, airports, and other subjects critical to remote pilots.

AIRMET — Airman's Meteorological Information—a current and forecast weather warning covering a specific area that is applicable to small aircraft and UAS (e.g., for windy conditions, turbulence, low visibilities).

AOA — Angle of attack—the angle between the middle of an airfoil (i.e., wing or rotor blade), referred to as the chord line, and the relative wind. Relative wind is opposite to the direction the aircraft/wing/rotor is moving.

ATC — Air traffic control—a service provided by ground-based personnel in charge of separating aircraft in controlled airspace. Remote pilots may have to contact ATC in specific situations.

ATCT — Air traffic control tower—a facility responsible for handling departures, arrivals, and ground operations at an airport (or airports).

ATIS — Automatic Terminal Information Service—a continuous broadcast of non-control aeronautical information. Provides weather information for the transmitting airport.

BVLOS — Beyond visual line of sight—anytime a drone is operated out of view of the remote PIC and visual observer. Special authorization is required for BVLOS operations.

CFI — Certificated Flight Instructor—an individual who is licensed to provide flight and ground instruction.

CFR — Code of Federal Regulations—the codification of the general and permanent rules and regulations published in the *Federal Register*. Title 14 of the CFR applies to areas of operation and certification of UAS and other aviation/aerospace vehicles.

civilian UAS remote pilots will be operating small UAS (sUAS), which are defined as those weighing less than 55 pounds. This text will focus on sUAS operations, though most of the details outlined are also applicable to larger UAS.

UAS are divided into two primary categories: fixed-wing and rotor-wing. Fixed-wing UAS generate the lift necessary to fly from a wing, just like a conventional aircraft. Rotor-wing UAS generate the lift needed to go aloft through rotors (essentially propellers oriented horizontally to provide lift vertically), just like a helicopter. Rotor-wing UAS are classified by the number(s) of rotors that they utilize for flight; for example, a UAS with a single rotor is considered a helicopter, while one with several rotors is referred to as a multicopter. A common configuration of four vertical propellers/rotors is referred to as a quadcopter. Figure 1-1 shows typical UAS configurations.

UAS use one of two types of engines to produce power to fly—internal combustion or electric. Internal combustion engines are typically used in larger UAS as well as in hobby/model aircraft, while electric seems to be the power source of choice for sUAS, particularly for multicopters. Obviously, internal combustion engines require some kind of fuel, a means to store it, and a way to induce combustion. Electric engines require a fuel of sorts, as well, in the form of batteries (or even solar panels). Because most of the various components needed for sophisticated sUAS use electricity, and conserving size as well as weight is important, batteries are the ideal choice for powering sUAS.

UAS COMPONENTS

Just like crewed aircraft, UAS are comprised of numerous subsystems that allow for controlled flight as well as more utilitarian functions such as providing navigation and position information, speed and altitude measurements, and the ability to take pictures and videos. Figure 1-2 shows the "guts" of a typical quadcopter. While internal components of sUAS vary in regards to size and capability, in general the innards of UAS are very similar. For example, all UAS have flight controllers, systems to manipulate the engine(s), a power source (battery or fuel), and a means to communicate with the ground station/controller, which the remote pilot uses to fly the UAS.

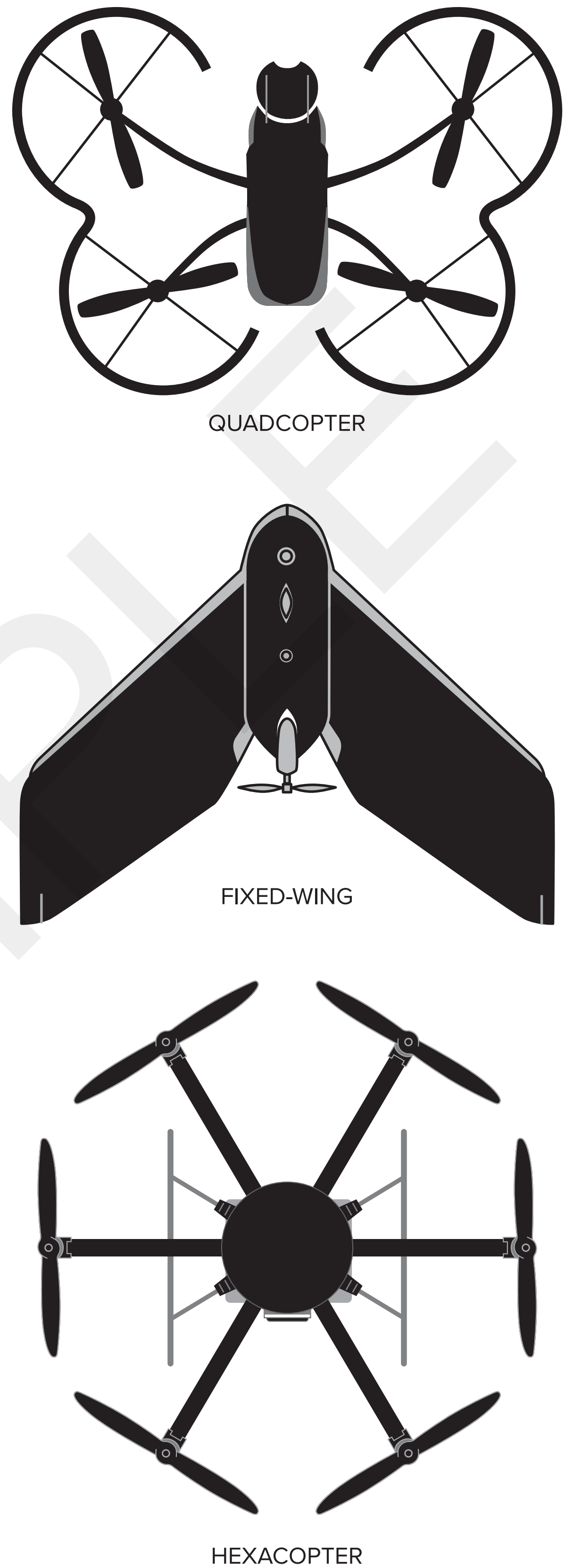

Figure 1-1. Typical UAS configurations.
(Halftermeyer; commons.wikimedia.org/wiki/File:Parrot_fleet_of_Drones.jpg; CC BY-SA 4.0)

Flight Controller

The brain of the UAS is the flight controller. This device interprets the inputs from sensors and the remote pilot's controller commands. Onboard sensors often include GPS, an inertial measurement unit (IMU), an altimeter, and a magnetometer (i.e., a fancy compass). Additionally, some UAS have autopilots to allow for autonomous navigation, which can be programmed to fly pre-planned routes, circle objects, or follow the remote pilot. The flight controller manipulates the speed of the motor(s) to execute the commands of the remote pilot or autopilot. It also is used to manipulate other sensors, such as the onboard camera. If installed, a GPS module can provide extremely accurate position information that can be used to superimpose the UAS position on a map (such as on a controller display or in FPV). GPS is available just about anywhere on Earth as long as the UAS has a clear "view" of the sky, thanks to the constellation of satellites that constantly transmit the data needed for the GPS module to determine its

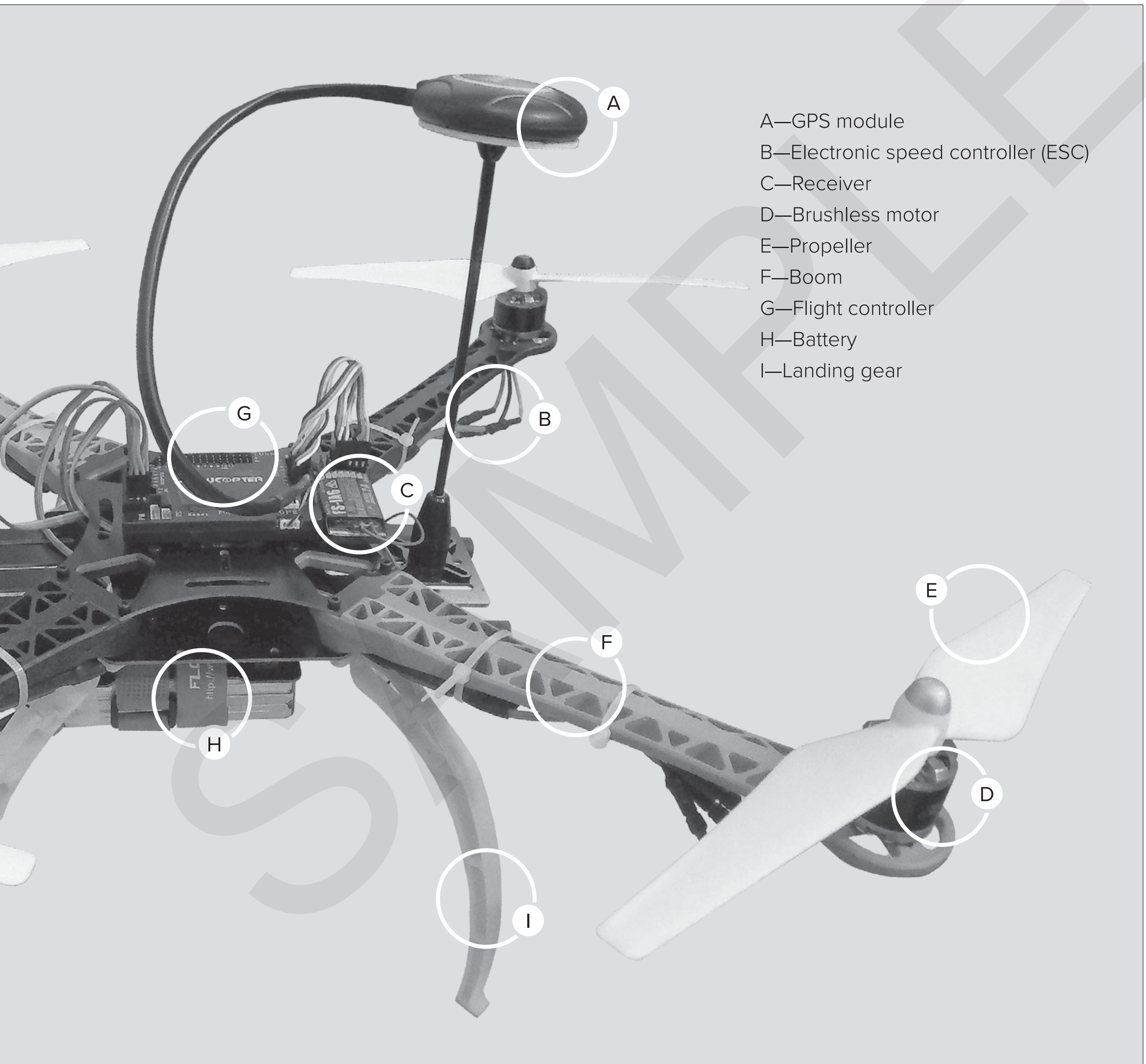

Figure 1-2. Typical quadcopter components.

- 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.
- 107.33—Visual observer.
- 107.35—Operation of multiple small unmanned aircraft.
- 107.37(a)—Yielding the right of way.
- 107.39—Operation over human beings.
- 107.41—Operation in certain airspace.
- 107.51—Operating limitations for small unmanned aircraft.
- 107.145—Operations over moving vehicles.

First responders and organizations responding to natural disasters may be eligible for an expedited waiver through the Special Government Interest (SGI) process. If you are conducting one of the below operations, you can apply for a waiver through the SGI process. This assumes you are a current Remote Pilot with a certificate or an existing Certificate of Waiver or Authorization (COA).

- Firefighting
- Search and rescue
- Law enforcement
- Utility or other critical infrastructure restoration
- Damage assessments supporting disaster recovery-related insurance claims
- Media coverage providing crucial information to the public

Part 107 Airspace Authorizations

In order to facilitate timely and flexible UAS operations in controlled airspace (e.g., Class B, C, D, E), the FAA started the Low Altitude Authorization and Notification Capability (LAANC) program. LAANC is a collaboration between the FAA and the private sector to provide UAS operators a means of requesting authorization to operate in airspace that otherwise would exclude such operations. Prior to LAANC, an operator would have to seek permission via means that could take days or weeks to receive. According to the FAA,[7] LAANC provides:

- Drone pilots with access to controlled airspace at or below 400 feet.
- Awareness of where pilots can and cannot fly.
- Air traffic control professionals with visibility into where and when drones are operating.

LAANC requests are routed through the FAA UAS Data Exchange and are checked using resources such as UAS facility maps, Special Use Airspace data, airports and airspace classes, Temporary Flight Restrictions (TFRs), and Notices to Air Missions (NOTAMs) (see Figure 2-3). If approved, pilots can receive their authorization in near real-time. LAANC authorizations are available to Part 107 and recreational users up to an altitude of 400 feet, while only those operating under Part 107 can apply for authorization at and above 400 feet.

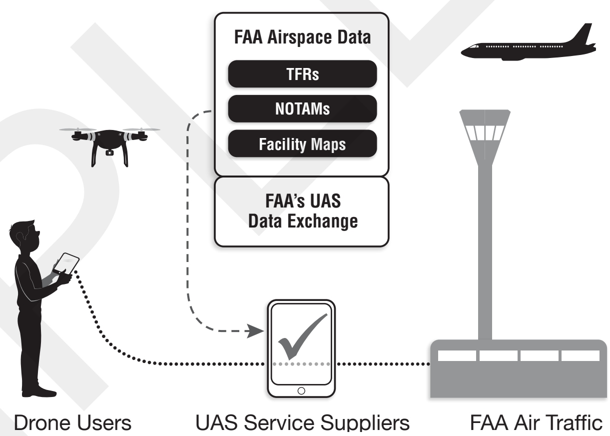

Figure 2-3. FAA's UAS Data Exchange and the Low Altitude Authorization and Notification Capability (LAANC).
(FAA UAS Data Exchange [LAANC], faa.gov/uas/programs_partnerships/data_exchange/)

Unless deemed necessary within the authorization, remote pilots are not required to contact the control tower prior to flight.

It is important to note that participation in LAANC does not eliminate the need for pilots to check NOTAMs, check weather conditions, and abide by all airspace restrictions. LAANC provides authorizations only to a specific airspace location.

LAANC is currently available at just over 700 airport locations. If LAANC is not available at a specific location, pilots must request authorization manually through the FAA's Drone Zone website.

7. "UAS Data Exchange (LAANC)," Federal Aviation Administration, U.S. Department of Transportation, last modified January 19, 2022, https://www.faa.gov/uas/programs_partnerships/data_exchange/.

LESSON 2

Review Questions

1. In which publication can pilots find information about air traffic control procedures?

   A—Air Traffic Control Trainee Handbook
   B—*Pilot's Handbook of Aeronautical Knowledge*
   C—*Aeronautical Information Manual*

2. The rules governing the recreational use of drones can be found in

   A—14 CFR Part 91
   B—49 USC §44809
   C—14 CFR Part 101

3. The part of 14 CFR that covers non-recreational use of sUAS is

   A—Part 91
   B—Part 101
   C—Part 107

4. Without proper notification of the airport operator and air traffic control (if applicable), a recreational sUAS operator cannot fly within ____ miles of an airport.

   A—3
   B—5
   C—recreational pilots are not required to maintain separation from airports

5. You experience a fly-away during which your sUAS crashes through a storefront window, causing $800 in damages. By when must you report this accident to the FAA?

   A—immediately
   B—within 3 calendar days
   C—within 10 calendar days

6. You experience a fly-away during which your sUAS crashes into a person, knocking them unconscious. They are transported to the hospital for care. Who must you report this event to?

   A—No report is required.
   B—Only the FAA.
   C—Both the FAA and the NTSB.

7. You experience a fly-away during which your sUAS hits a house, causing $500 in damage to the garage door. Additionally, your sUAS, valued at $1,200 is destroyed. By when must you report this accident to the FAA?

   A—No report is required.
   B—Within 3 calendar days.
   C—Within 10 calendar days.

8. Which of the following operations is not covered by 14 CFR Part 107?

   A—Flying an sUAS to take pictures of a house for personal use.
   B—Flying an sUAS to take pictures of a house for business use.
   C—Flying an sUAS to survey a farm to provide precision agricultural services.

9. Which of the following UAS do not need to be registered with the FAA?

   A—Model aircraft used recreationally weighing 3 pounds.
   B—sUAS used recreationally weighing 0.50 pounds.
   C—sUAS used for business weighing 5 pounds.

Most of the time, non-towered airports exist in Class G airspace and you will want to monitor the Common Traffic Advisory Frequency (CTAF) and other applicable frequencies with an aviation band scanner. If FCC licensed, you can broadcast information about your flight operations on a common frequency. This is often accomplished via UNICOM, an informal radio station that is not operated by the government but by a private business as a service to the flying public. The operator has many other duties, and may not always be able to answer your call. Information on runway in use received from a UNICOM is advisory only. If you are unable to communicate with UNICOM, the *AIM* suggests that you broadcast in the blind (no specific addressee: "Plant City traffic, DJI one two one four x-ray is about to depart ramp area adjacent to the airport beacon, Plant City") on the CTAF for that airport.

Some non-towered airports have surface-based Class E airspace associated with them. If you recall from the regulations governing sUAS under Part 107, you need permission to operate in this type of airspace. Remember, though, that "on the spot" authorizations to fly in this type of airspace may not be possible; instead, remote pilots should submit an airspace waiver form to the FAA well prior to any operations.

You will occasionally find runways at non-tower airports marked off with a large X at each end or in the center. An X-ed off *runway* is closed, and an X in the center of an airport indicates that the *airport* is closed. Do not use areas of pavement or runway with chevron markings upon them, as this indicates that the areas are unusable. Figure 4-9 includes a closed runway, an unusable taxiway, displaced thresholds, and parallel runways.

Because no clearance is required to operate at a non-tower airport, it is not required that you maintain continuous radio contact with the ground station or other aircraft. The *AIM* does recommend that you announce your position and intentions when within 10 miles as well as announce how you are operating or maneuvering in the area and around the airport so that other pilots in the area can coordinate their movements with yours. Also, because the CTAF may be shared by several airports, listen carefully for traffic that may be in your immediate area (i.e., they are using the name of the closest airport). If you have a FCC license and are transmitting information about your

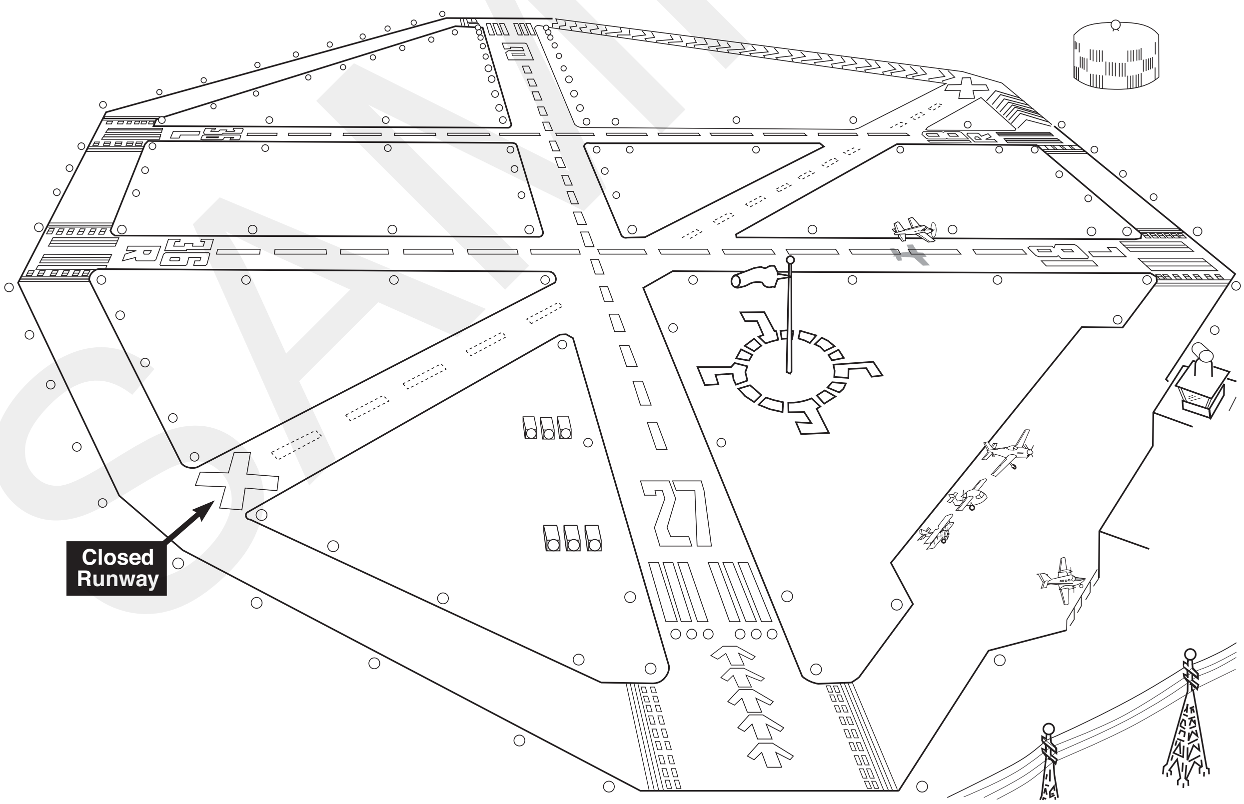

Figure 4-9. Airport runway and taxiway markings.

REMOTE IDENTIFICATION (RID)

The FAA has been working on new technology to track unmanned aircraft within the National Airspace System (NAS) called Remote Identification (RID). It is available now but will be required on all unmanned aircraft operating within the NAS by September 16, 2023. This technology allows for a safer and more secure integration of uncrewed aircraft into the NAS.

Effective September 16, 2023, no person may operate an unmanned aircraft within the airspace of the United States unless the operation meets the requirements of 14 CFR §89.110 (standard remote identification) or §89.115 (alternative remote identification) unless otherwise authorized by the FAA.[1]

Remote ID is the ability of a drone in flight to provide identification and location information via radio frequency (e.g., Wi-Fi or Bluetooth) that can be received by other parties. This information includes:

- A unique identifier for the drone;
- The drone's latitude, longitude, geometric altitude, and velocity;
- An indication of the latitude, longitude, and geometric altitude of control station (standard) or take-off location (broadcast module);
- A time mark; and
- Emergency status (standard remote ID drone only).

The above information helps the FAA, law enforcement, and other federal agencies find the control station when a drone appears to be flying in an unsafe manner or where it is not allowed to fly. Remote ID also lays the foundation of the safety and security groundwork needed for more complex drone operations.

There are two types of Remote ID available, and you must comply with only one.

Standard remote identification broadcasts identification and location information about the drone and its control station (Figure 5-5). A standard remote ID drone is one that is manufactured with built-in remote ID broadcast capability per the remote ID rule's requirements. For operations using standard remote identification, you must comply with the requirements of 14 CFR §89.110.

1. "Remote Identification for Drone Pilots," Federal Aviation Administration, U.S. Department of Transportation, last modified October 13, 2021, https://www.faa.gov/uas/getting_started/remote_id/drone_pilots/.

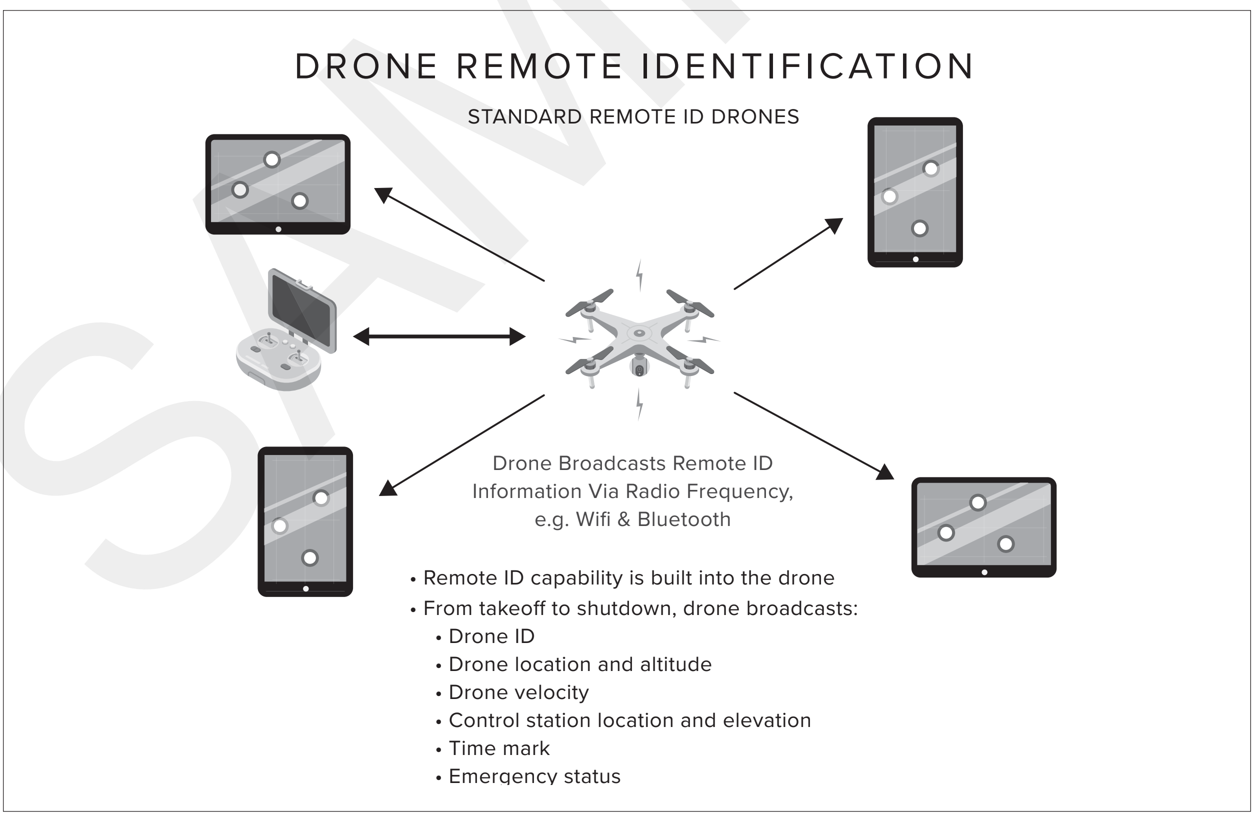

Figure 5-5. Standard remote ID drones. *(FAA)*

THE COMPLETE REMOTE PILOT

SECOND EDITION Bob Gardner and David Ison

This textbook is for anyone interested in pursuing and obtaining a Remote Pilot Certificate, which is required in order to operate drones for commercial use. With a friendly and readable style, the authors cover all of the details involved in becoming a competent, responsible, and safe remote pilot, opening up tremendous opportunities for flying increasingly affordable and sophisticated small uncrewed aircraft systems (sUAS).

An FAA Knowledge Exam is a requirement for earning a Remote Pilot Certificate. *The Complete Remote Pilot* is designed to not only prepare you for the exam but to teach you about how drones fly, their components and systems, and the aeronautical knowledge required to fly in the same airspace as crewed aircraft. This book covers specifics on drone terminology, regulations, airspace and navigation, airport and off-airport operations, radio communication procedures, weather, aerodynamics and aircraft performance, emergency procedures, human factors, maintenance, and preflight inspection procedures.

This second edition incorporates regulation changes in 14 CFR Parts 89 and 107 for sUAS equipment; operating at night and over people; remote pilot knowledge, training, and certification; and remote identification of uncrewed aircraft. The required aeronautical knowledge is augmented with specific tips and techniques, checklists, and mnemonic devices, as well as review questions for each chapter similar to the type found on the FAA test, a comprehensive glossary, and index. You will gain the practical knowledge needed to pass the FAA Knowledge Exam and understand how to operate safely as a remote pilot in the U.S. National Airspace System.

BOB GARDNER began his flying career in Alaska in the U.S. Coast Guard. Over the next 50+ years, he earned his ATP and Instructor certificates, flew commercially, and operated as a designated examiner, Director of ASA Ground Schools, author, journalist, and airshow lecturer.

Dr. DAVID ISON is a professor in the graduate school at Northcentral University. He has been involved in aviation for more than 35 years, including 6,000 flight hours as a flight instructor and ATP and 15 years in aviation higher education. He has a wide array of experience with fixed-wing and multicopter drones.

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