2020

Pass the FAA Drone Pilot Test—Remote Pilot Exam Preparation 2020

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Preface

Part 107 is the subdivision of Subchapter F of Chapter 1 of Title 14 that pertains to small unmanned aircraft systems (sUAS). To legally fly a small unmanned aircraft for non-hobby, non-recreational use, remote pilots must abide by these regulations. This book is intended to explain the Part 107 regulations in a short and easy to read format. Additionally, this book also covers other areas of knowledge required by the FAA, including airspace and requirements, weather, loading and performance, and operations.

If you plan to become a remote pilot, becoming familiar with the information presented here is an excellent first step.

I sincerely hope you enjoy reading this book.

Best Regards,

Nicolas R. Malloy

Keys to Success

The chapters in this book cover a broad range of topics the FAA wants you to know. The initial aeronautical knowledge test includes the following areas of knowledge:

» Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation

» Airspace classification, operating requirements, and flight restrictions affecting small unmanned aircraft operation

» Aviation weather sources and effects of weather on small unmanned aircraft performance

» Small unmanned aircraft loading

» Emergency procedures

» Crew resource management

» Radio communication procedures

» Determining the performance of small unmanned aircraft

» Physiological effects of drugs and alcohol

» Aeronautical decision-making and judgment

» Airport operations

Readers also have access to a series of sample test questions. Readers should practice with these test questions until achieving at least a score of 90% before attempting the exam. The author strives to make the questions as similar as possible to the official FAA Exam. However, the FAA does not provide specific test-questions to the public. The sample questions here are based on the information available through documentation and research.

The sample questions in this book refer to legends and figures from the ***FAA-CT-8080-2H Airman Knowledge Testing Supplement***. FAA-CT-8080-2H is the testing supplement provided to test-takers during the official aeronautical knowledge test. Readers need to familiarize themselves with these legends and figures before attempting to take the test. For the best experience, the author recommends the **printed** version of this book.

Chapter 1: Regulations

CFR stands for the **Code of Federal Regulations**. You can find the Code of Federal Regulations (CFR) in the Federal Register. It contains codification and permanent rules established by the U.S. Federal Government agencies and departments. The Federal Register divides the Code of Federal Regulations into fifty **titles**. Each title represents broad topics regulated by the Federal Government. Titles are divided into **chapters** that usually bear the name of the department or agency issuing the regulation. Chapters are further subdivided into **subchapters** and **parts** that cover specific areas of regulation.

Applicability and General Information

Title 14 covers regulations and codes that are related to aeronautics and space. **Chapter 1** of Title 14 are regulations issued by the Federal Aviation Administration (FAA) and the Department of Transportation. **Subchapter F** relates to air traffic and general operating rules. **Part 107** is the subdivision of Subchapter F of Chapter 1 of Title 14 that pertains to small unmanned aircraft systems (sUAS). This book refers to these regulations as simply Part 107. You can read Part 107 directly on the ***U.S. Government Publishing Office website***[1]. In this book, you will also encounter references contrasting Part 107 with **Part 101**, which relates to model aircraft and recreational use.

Aircraft and Operations That Fall Under Part 107

Part 107 applies to the **non-hobby** or **non-recreational** use of small unmanned aircraft systems (sUAS). For example, suppose you were using your small unmanned aircraft to make virtual tours of homes for a local real estate agent, and you were getting paid for the photos and video. Would Part 107 apply in this situation? The answer is **yes**. In this situation, the operation would fall under Part 107 because the FAA would consider this a commercial activity. However, suppose you were to take the same small unmanned aircraft to the local park to make videos of your family outing. Would Part 107 apply? The answer is **no**. Even if you used the same aircraft, this type of use would not fall under Part 107 because there was no compensation involved. Instead, this type of operation would fall under Part 101, which covers recreational and hobby use. As one can see, whether or not Part 107 applies has more to do with one's activities rather than the aircraft.

A **small unmanned aircraft system (sUAS)** includes the small unmanned aircraft as well as any associated elements required for the safe and efficient operation of the small unmanned aircraft in the national airspace system. People often refer to a small unmanned aircraft as a **drone**. Part 107 defines a **small unmanned aircraft** as an unmanned aircraft weighing **less than 55 pounds** on takeoff, including everything that is on board or otherwise attached to the aircraft. For example, suppose your drone weighs 40 pounds, and you attached a package to it weighing 15 pounds. Would the drone still be considered a small unmanned aircraft under Part 107? The answer is **no**. The total weight is 55 pounds. According to Part 107, the aircraft and everything that is on board or otherwise attached to the aircraft must be **less than 55 pounds**.

1 URL–https://www.ecfr.gov/cgi-bin/text-idx?SID=4126445f83285fb99751a7af806c3bdf&mc=true&node=pt14.2.107&rgn=div5

One area of misunderstanding stems from the weight limits of model aircraft under Part 101, which describes it as not more than 55 pounds. In the previous example, the aircraft could be operated for recreational or hobby use under Part 101 because the total weight was **not more than 55 pounds**. Further, Part 107 defines an **unmanned aircraft** as any aircraft operated without the possibility of direct human intervention from within or on the aircraft. The term system in small unmanned aircraft system applies to both the aircraft and the associated elements. The **associated elements** of a small unmanned aircraft system include, but are not limited to the following:

» communication links

» the control station

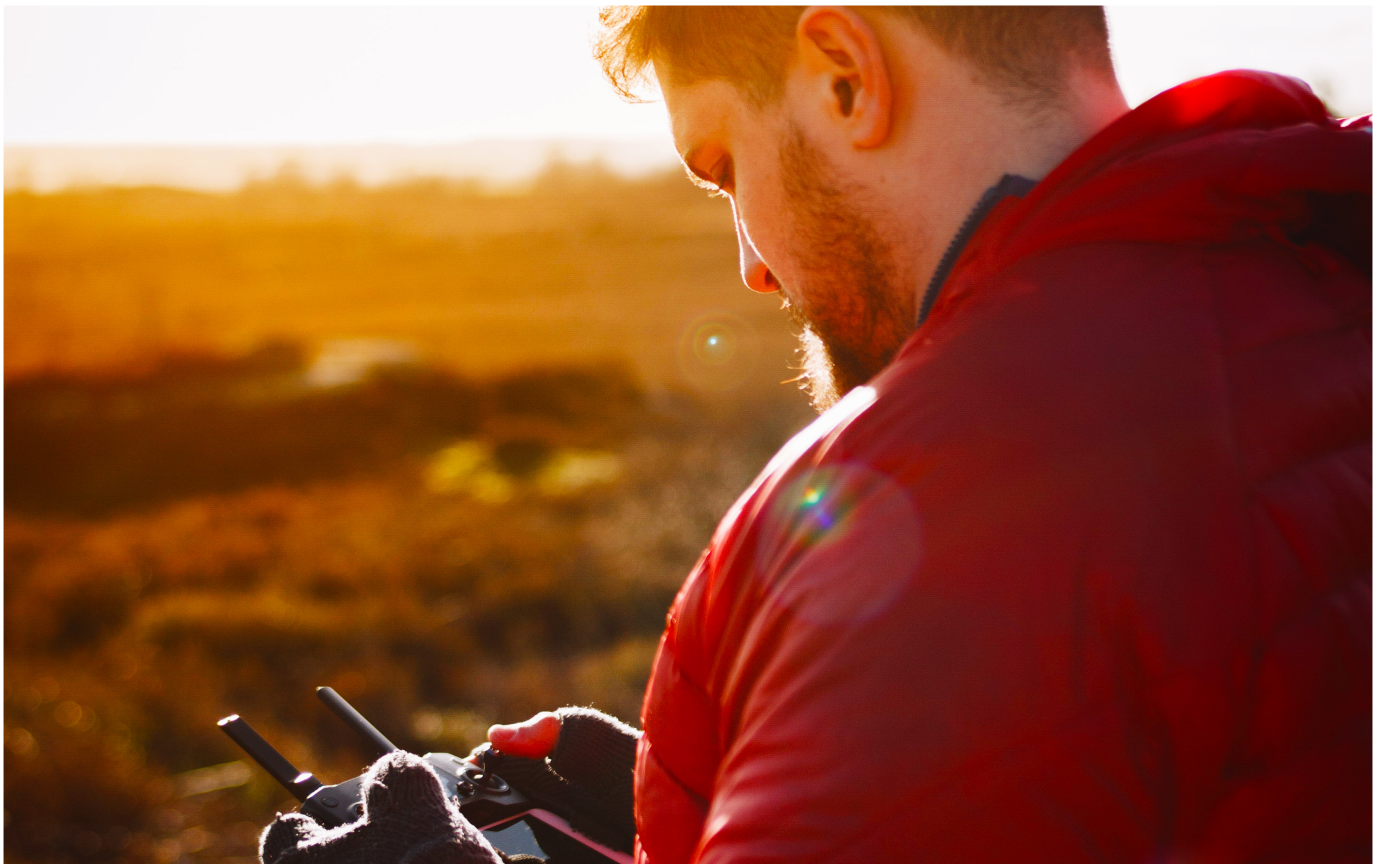
» the crew

The crew can consist of one or more persons, including the following roles:

» the remote pilot in command (PIC)

» the visual observer (VO)

» the person manipulating the flight controls



The **control station** is the interface used by the remote pilot to control the flight path of the small unmanned aircraft. A **remote pilot in command (PIC)** is the person that possesses a remote pilot certificate with a small UAS rating and is responsible for the operation and safety of the flight. A **visual observer (VO)** is a person who is designated by the remote pilot in command to assist the remote pilot in command and the person manipulating the flight controls of the small UAS to see and avoid other air traffic or objects aloft or on the ground. The FAA recommends that visual observers systematically focus on different segments of the sky for short intervals. Specifically, visual observers should scan the sky in **10° sectors**. The FAA also wants remote pilots to understand the effects haze has on the ability to see traffic or terrain features during flight. **Haze** causes objects to appear farther than their actual distance. There may be additional elements of a small unmanned aircraft system, including radio communication, cell phones, tablets, and supplementary crew members.

Part 107 does not apply to any aircraft subject to the provisions of Part 101, which regulates model aircraft flown for hobby or recreational use. Part 107 also does not apply to the following:

- air carrier operations
- government aircraft operations
- interstate commerce
- operations conducted outside the United States.

A **government aircraft** also referred to as a **public aircraft**, is defined as any aircraft owned by the United States government used only for government aircraft operations.

Records, Inspection, and Reporting

Though it should be obvious, the FAA does not want you to lie to them or others about documentation and compliance. The language in Part 107 indicates the consequences of altering or producing fraudulent records, reports, certifications, ratings, or authorizations. A person that commits these acts may be denied a remote pilot certificate, have their certificate revoked or suspended, and also face a civil penalty.

Under Part 107, you are also required to submit to an inspection by the FAA. At any time, the FAA may request proof of remote pilot certification. The FAA may also ask to see any other document, record, or report required under Part 107. The FAA may also request to inspect and test your aircraft to determine compliance. Inspection is not just limited to aircraft. The FAA may question the remote pilot in command, the person manipulating the flight controls of a small unmanned aircraft system, the visual observer, and any other member of the crew.

Under certain circumstances, the remote PIC must report accidents to the FAA no later than ten calendar days after the incident. Accidents that require reporting to the FAA include serious injury to a person or accidents that cause a person to lose consciousness. According to the National Transportation Safety Board (NTSB), a **serious injury** is an injury that requires an individual to be hospitalized for more than 48 hours, commencing within seven days from the date the injury was received. However, for testing purposes, the FAA may consider a serious injury to include **any overnight hospital stay**., not just those that are more than 48 hours. For example, suppose you crashed your small unmanned aircraft into a member of your crew. The crew member suffered scrapes, cuts, and bruising that required first aid treatment. Would this incident need to be reported to the FAA? The answer is **no**. Not unless the crew member later went to the hospital as a result of the injuries and required an overnight stay.

Accidents must also be reported under certain circumstances when damage to any property, other than the small unmanned aircraft occurs **exceeds 500 dollars**. If the damage to property does not cost more than 500 dollars to replace, then no reporting is necessary. Alternatively, if the damage to the property does not cost more than 500 dollars to repair, you also do not have to report the accident. The reporting requirement falls under whichever is least expensive, repairing, or replacing. For example, suppose you were hired to take photos of a house for a local real estate agent and crashed your small unmanned aircraft into a car. As a result, the windshield cracked. The cost of repairing the windshield is 200 dollars. The cost of replacing the windshield is 600 dollars. Would you need to report this incident? The answer is **no**. Because the cost of repairing the windshield is less than 500 dollars, you do not need to report the accident.

In addition to the FAA reporting requirements, the NTSB also has accident reporting requirements that apply to small unmanned aircraft as well as manned aircraft. The National Transportation Safety Board (NTSB) accident reporting requirements are defined in ***49 CRF Part 830***[1]. Reportable events include accidents involving death or serious injury, a flight control system malfunction or failure (such as a fly-aways), an in-flight fire, and an aircraft collision in flight. If there is no significant damage other than to the aircraft, the NTSB will most likely not conduct an investigation.

1 URL: http://www.ecfr.gov/cgi-bin/text-idx?SID=13dce6f0c4d3a277f54df702e23ec07c&mc=true&node=pt49.7.830&rgn=div5

Operating Rules

Under Part 107, you must have a **remote pilot certificate with a small UAS rating** to operate the flight controls on a small unmanned aircraft system. Alternatively, a person may work the flight controls if they are under the direct supervision of a remote pilot in command. The remote pilot in command must have a remote pilot certificate with a small UAS rating. The remote pilot in command must also have the ability to immediately take direct control of the flight of the small unmanned aircraft. For example, suppose you were training an employee to operate a small unmanned aircraft system for agricultural inspection and pesticide application. The trainee does not have a remote pilot certificate. Would the trainee be allowed to work the flight controls? The answer is, maybe. If you possessed a remote pilot certificate with a small UAS rating and were close enough to take manual flight control if necessary, then the answer is **yes**. If not, then the answer would be no. As another example, suppose you took your 12-year-old nephew to the beach to fly a small unmanned aircraft for fun. Would your 12-year-old nephew be allowed to operate the flight controls without direct supervision? The answer is **yes**. Because the pilot flew the aircraft for recreational use, the operation falls under Part 101, and there is no restriction on who can operate the flight controls.

Under certain circumstances, the FAA may authorize an airman to operate a civil foreign-registered small unmanned aircraft without an FAA-issued remote pilot certificate with a small UAS rating.

Registration and Marking Requirements for Small Unmanned Aircraft

Under Part 107, small unmanned aircraft must be registered at least once every three years with the FAA before they can fly in the national airspace system. Unless renewed, a Certificate of Aircraft Registration expires **three years** after the date of issue. If the aircraft weighs **0.55 pounds or less** on takeoff, including everything that is on board or otherwise attached to the aircraft, then registration with the FAA is *not required*.

A U.S. citizen must own the aircraft to be eligible for registration. In this instance, a **U.S. citizen** may be an **individual** or a **partnership** where both partners are U.S. citizens. The term U.S. citizen also applies to a **corporation** organized under the laws of the United States or a State, the District of Columbia, or a territory or possession of the United States.

A resident alien may also be eligible to register the aircraft with the FAA. A **resident alien** is an individual citizen of a foreign country lawfully admitted for permanent residence in the United States as an immigrant in conformity with the regulations of the Department of Homeland Security.

When registering a small unmanned aircraft, you must use the owner's legal name unless the owner is less than 13 years of age. If the owner is less than 13 years of age, then the small unmanned aircraft must be registered by a person who is *at least* **13 years of age**. The holder of a Certificate of Aircraft Registration must ensure that the information provided remains accurate. When any change in registration information occurs, such as a change in your name or physical address, you must update the information using the web-based small unmanned aircraft registration system within 14 calendar days. You can find details on small unmanned aircraft registration on the ***FAA website***[1]. If the small unmanned aircraft is registered in a foreign country or is owned, controlled, or operated by someone who is not a U.S. citizen or permanent resident, then it will require a **foreign aircraft permit**.

Part 107 requires your small unmanned aircraft to display a unique identifier. A **unique identifier** is typically the registration number. In some cases, the FAA may authorize the use of the small unmanned aircraft serial number as a unique identifier. You must maintain the unique identifier in a legible condition that will stay on the aircraft for the duration of each operation. The unique identifier must be readily available and visible upon inspection of the small unmanned aircraft. If you enclose the marking in a compartment, it must be accessible without the use of any tool. Conventional methods for marking a small unmanned aircraft with a unique identifier are self-adhesive labels, permanent markers, or engravings.

1 URL: http://www.faa.gov/licenses_certificates/aircraft_certification/aircraft_registry/

Remote Pilot in Command Responsibilities for Safety and Emergencies

The **remote pilot in command (PIC)** is the person that possesses a remote pilot certificate with a small UAS rating and is responsible for the operation and safety of the flight. They are the final authority during operations. A person may not operate or act as a remote pilot in command or visual observer in the operation of more than one unmanned aircraft at the same time. For example, suppose you needed to map a stretch of river and had three small unmanned aircraft in your fleet. To save time and maximize daylight operations, you want to use the three aircraft simultaneously. What would be the minimum number of people you would need to perform this operation? The answer is **three**. Under Part 107, you would need a minimum of three persons for this type of operation, and each person would have to meet the qualifications to act as the remote pilot in command.

Certain medical conditions may also prohibit flight operations. Under Part 107, no person may manipulate the flight controls of a small unmanned aircraft system if they have a physical or mental condition that would interfere with safe operations. These conditions also restrict anyone from acting as a remote pilot in command, a visual observer, or any other direct participant in the operation of the small unmanned aircraft.

Typically, the remote PIC is designated before the flight. However, the designation may be transferred from one person to another during operations. For example, suppose the remote PIC received a phone call in the middle of a flight operation that they needed to answer. He or she could designate another certified remote pilot to take command. The new person would become the remote pilot in command and take responsibility for the flight operations from that point forward.

The remote PIC must ensure that the small unmanned aircraft will pose no undue hazard to other people, other aircraft, or other property in the event of a loss of control of the aircraft for any reason. The remote pilot in command must also ensure

that the small UAS operation complies with all applicable regulations. The remote PIC must also have the ability to direct the small unmanned aircraft to ensure compliance with the applicable provisions of Part 107.

According to Part 107, no person may operate a small unmanned aircraft system unless it is in a condition for safe operation. It is the responsibility of the remote pilot in command to check the small unmanned aircraft system to determine whether or not it is in a sound condition. During the flight, if any member of the crew decides that the aircraft is no longer in a safe condition, the flight operations must stop.

Before the flight, the remote pilot in command must assess the operating environment, considering risks to persons and property in the immediate vicinity both on the surface and in the air. The assessment must include the following:

» local weather conditions
» local airspace and any flight restrictions
» the location of persons and property on the surface
» any other ground hazards

The remote pilot in command must also ensure that all persons directly participating in the small unmanned aircraft operation are informed about the following:

» operating conditions
» emergency procedures
» contingency procedures
» roles and responsibilities
» potential hazards

Also, the remote pilot in command must perform tests and inspections to ensure that all control links between the ground control station and the small unmanned aircraft are working correctly. If the small unmanned aircraft is powered, the remote pilot in command must ensure that there is enough available power for the small unmanned aircraft system to operate for the intended operational time. The remote pilot in command is responsible for confirming that any object attached or carried by the small unmanned aircraft is secure and does not adversely affect the flight characteristics or controllability of the aircraft.

When there is an in-flight emergency that requires immediate, the remote pilot in command is allowed to respond **in any manner to address the emergency**, even if it breaks the rules under Part 107. Each remote pilot in command who deviates from a rule due to an emergency must send a written report of that deviation to the FAA if requested. For example, suppose you were flying or small unmanned aircraft while mapping a region of wetlands for a non-profit conservation group. To avoid collision with a flock of geese in-flight, you fly your aircraft to an altitude of 800 feet above ground level. In most circumstances, Part 107 prohibits you from flying more than 400 feet above ground level. Responding to this emergency allows you to break this rule. You would not have to report this incident to the FAA unless they contact you and make a request asking you to do so.

Operating Limitations for Small Unmanned Aircraft

A remote pilot in command and the person manipulating the flight controls of the small unmanned aircraft system must comply with certain operating limitations when operating a small unmanned aircraft system. Part 107 prohibits remote pilots from flying directly over people in most circumstances. It states that no person may operate a small unmanned aircraft over a human being unless that human being is directly participating in the operation of the small unmanned aircraft. You are allowed to fly over non-participants if they have enough cover that can provide reasonable protection from a falling small unmanned aircraft. For example, suppose you were flying your small unmanned aircraft for a local news organization, and several people were located on the scene. Some people, including your flight crew, were out in the open. Others were positioned under a covered bus stop. A few people were watching the scene from inside a parked car. Over which persons could you fly? You would be allowed to fly over your crew, the people under the covered bus stop, and the people in the parked car. You would not be allowed to operate directly over any other people out in the open.

Under Part 107, a remote pilot or a visual observer must maintain a visual line of sight to the aircraft. A remote pilot or visual observer must make a **visual line of sight (VLOS)** with vision that is unaided by any device other than corrective lenses to know the aircraft's location, attitude, altitude, and direction of flight. Visual line of sight is also maintained to check the airspace for other air traffic or hazards and to determine that the unmanned aircraft does not endanger the life or property of another. The FAA recommends that visual observers systematically focus on different segments of the sky for short intervals. Specifically, visual observers should scan the sky in **10° sectors**. Throughout the entire flight, the visual line of sight must be exercised by the remote pilot in command, and the person that is manipulating the flight controls of the small unmanned aircraft system. Alternatively, a visual observer may be used to maintain the visual line of sight.

If a visual observer is used during the aircraft operation, they must sustain effective communication at all times with the remote pilot in command. The visual observer must coordinate with the remote pilot in command to maintain awareness of the position of the small unmanned aircraft through direct visual observation, and to scan the airspace where the small unmanned aircraft is operating for any potential collision hazard. If the person manipulating the flight controls is different from the remote pilot in command, then the visual observer must maintain effective communication with both. The remote pilot in command is responsible for ensuring that the visual observer can see the unmanned aircraft and keep the visual line of sight.

There are also some limitations related to atmospheric conditions and flight visibility. To fly, the minimum flight visibility, as observed from the location of the control station, must be no less than three statute miles. The FAA defines **flight visibility** as the average slant distance from the control station at which prominent unlighted objects may be seen and identified by day, and prominent lighted objects may be seen and identified by night. Also, the minimum distance of the small unmanned aircraft from clouds must be **no less than 500 feet** below the cloud and **2,000 feet horizontally** from the cloud.[**Figure 1–1**]. For example, suppose you wanted to fly your small unmanned aircraft to take wedding photos for hire. It's a slightly foggy day, and you can't see more than two statute miles from your position in any direction. However, where you are at, it is clear enough to maintain a visual line of sight. Also, you don't plan to fly closer than 2000 feet from the fog. Are you allowed to operate in these conditions under Part 107? The answer is **no**. Even though you are more than 2000 feet horizontally from the fog, the overall flight visibility is less than three statute miles. Though the FAA wants remote pilots to be aware of atmospheric conditions that may affect flight visibility, most accidents or mid-air collisions occur on **clear days**.

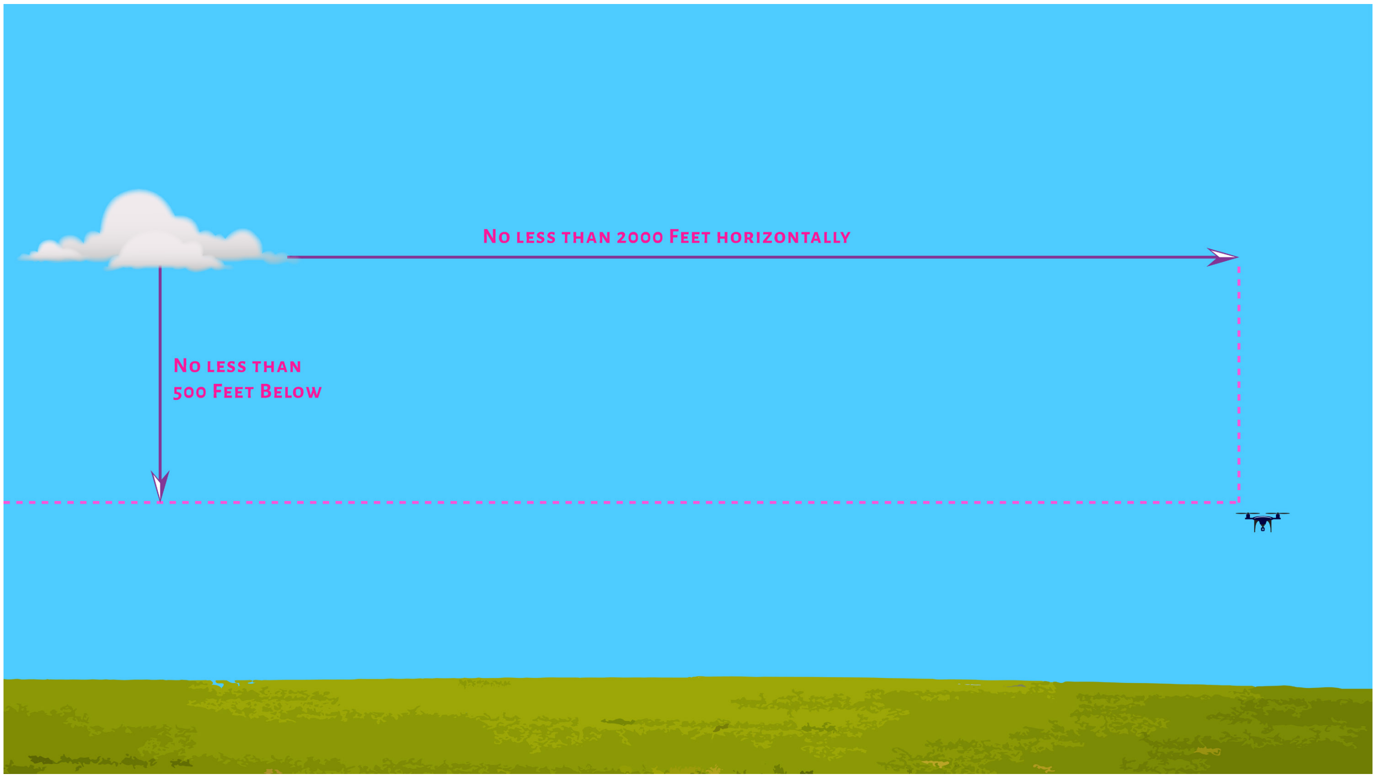


Figure 1–1: Atmospheric limitations diagram.

Under Part 107, remote pilots may not fly a small unmanned aircraft faster than a groundspeed of **87 knots (100 miles per hour)**. Also, the altitude of the small unmanned aircraft cannot be higher than **400 feet** above ground level. There are some exceptions to this rule. If a remote pilot flies a small unmanned aircraft within a **400-foot radius** of a structure, they can fly the aircraft higher than 400 feet [**Figure 1–2**]. For example, suppose you were inspecting wind turbines for a regional power company. The height of the tower and blades was 318 feet above ground level. How high could you fly a small unmanned aircraft when inspecting the wind turbines? You would be able to fly up to 718 feet above ground level as long as you stayed within 400 feet of the tower and blades.

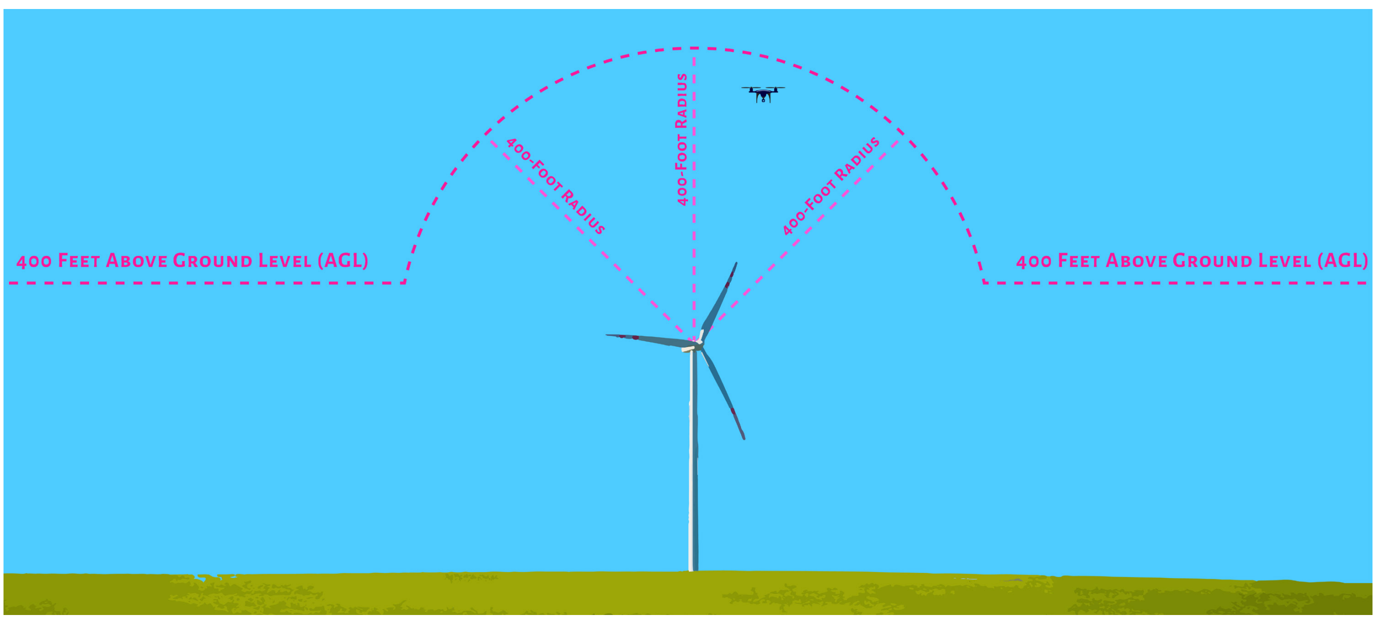


Figure 1–2: Altitude limitations within 400 feet of a structure or obstacle

Limitations Related to Reckless Operations and Hazardous Situations

Under Part 107, remote pilots are prohibited from operating a small unmanned aircraft carelessly or recklessly or in a manner that endangers the life or property of another. Remote pilots are also not allowed to drop an object from an aircraft in a way that creates an undue hazard to persons or property. For example, some reckless actions may include the following:

- interfering with other aircraft
- overloading the aircraft with cargo beyond its carrying capacity
- flying close to non-participants in a manner that risks accidental injury

Remote pilots are also not allowed to operate a small unmanned aircraft system from a moving aircraft. For example, suppose you were working for a news organization and decided to fly your small unmanned aircraft from a flying helicopter to record video of a scene. Unless you had a waiver from the FAA authorizing this type of operation, this action would be a violation of Part 107.

Operations from moving vehicles or boats *are* allowed under Part 107. However, the remote pilot must fly the small unmanned aircraft over a sparsely populated area. If you are operating from a moving vehicle or boat, Part 107 prohibits you from transporting another person's property for compensation or hire. For example, suppose you were working for a popular online retailer delivering small packages of goods with your small unmanned aircraft. Your delivery vehicle would be required to remain stationary while flight operations took place. No drive-by drone delivery would be allowed.

The FAA prohibits anyone from acting as a crew member of a small unmanned aircraft flight operation if they have consumed any alcoholic beverage within the previous eight hours. Participants cannot be under the influence of any drugs that affect a person's faculties in any way contrary to safety. Though it may seem redundant, the FAA also prohibits a person from serving as a remote pilot in command if they have a blood alcohol concentration of **.04 or greater**.

The FAA also prohibits the transportation of specific items, including narcotic drugs, marijuana, and depressant or stimulant drugs or substances. Also, a small unmanned aircraft may not carry hazardous material. A **hazardous material** is defined as a substance or material that the Secretary of Transportation has determined is capable of posing an unreasonable risk to health, safety, and property. There is one crucial exception. Lithium batteries installed in your small unmanned aircraft for power are not considered hazardous. However, additional lithium batteries that not connected for power are considered hazardous and cannot be carried.

Unless you have a waiver from the FAA, **nighttime operations are prohibited**. Under Part 107, remote pilots must fly during the day or civil twilight. **Civil twilight** that as a period that begins 30 minutes before official sunrise and ends at dawn. It is also a period that starts at official sunset and ends 30 minutes after official sunset. If you are in Alaska, refer to the Air Almanac to determine when civil twilight occurs. Remote pilots may operate during civil twilight as long as the aircraft is equipped with anti-collision lighting that is visible for at least three statute miles. Remote pilots are allowed to reduce the intensity of the anti-collision light if he or she determines that, because of operating conditions, it would be in the interest of safety to do so.

Limitations Related to Region and Airspace

Remote pilots must yield the right of way to all aircraft, airborne vehicles, and launch and reentry vehicles. According to the FAA, yielding the right of way means that the small unmanned aircraft must give way to the aircraft or vehicle and may not pass over, under, or ahead of it unless well clear. No person may operate a small unmanned aircraft so close to another aircraft as to create a collision hazard. Also, remote pilots must get prior authorization from **Air Traffic Control (ATC)** to operate in certain classes of airspace. Part 107 states that no person may operate a small unmanned aircraft 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 unless that person has prior authorization from Air Traffic Control (ATC). You will learn more about airspace classifications in a later chapter. Additionally, no person may operate a small unmanned aircraft in a manner that interferes with operations and traffic patterns at any airport, heliport, or seaplane base.

Remote pilots are not allowed to fly in prohibited or restricted areas unless that person has permission from the using or controlling agency, as appropriate. Remote pilots must also comply with special security instructions issued by the FAA when flying in an air defense identification zone (ADIZ). An **air defense identification zone (ADIZ)** means an area of airspace over land or water in which the ready identification, location, and control of all aircraft (except for Department of Defense and law enforcement aircraft) are required in the interest of national security.

Sometimes the FAA will temporarily restrict flight operations in the vicinity of a disaster or hazard area. In these types of situations, the FAA will issue a **notice to airmen (NOTAM)** designating an area within which temporary flight restrictions apply. The notice to airmen will specify the hazard or condition that triggered the temporary flight restrictions. The FAA may also issue a notice to airmen designating an area of airspace in which a temporary flight restriction applies due to major sporting events or aerial demonstrations in the area. The Notice to Airman will state the name of the aerial demonstration or sporting event and specify the effective dates and times, the geographic features or coordinates, and any other restrictions or procedures governing flight operations in the designated airspace. The remote pilot in command is responsible for checking if any NOTAMs have been issued before flight operations take place.

Remote Pilot Certification

A **pilot certificate** issued by the FAA is akin to a license to fly. The FAA issues several different types of certificates, each requiring different levels of training and education. The type of certificate a pilot carries will determine what kind of aircraft and in what context of which they can fly. For example, a private pilot certificate would allow a pilot to operate specific types of single-engine aircraft for non-commercial use.

The FAA may also issue a **rating** to go along with a certificate. A rating can be added to a certificate to expand the type of aircraft and the context with which a pilot can fly. For example, a pilot could add an instrument rating to a private pilot certificate. The **instrument rating** would allow the pilot to operate by only referencing the instruments in the flight deck. Part 107 prescribes the requirements for issuing a **remote pilot certificate** with a **small unmanned aircraft system rating**.

Eligibility Requirements

The FAA sets specific eligibility requirements to receive a remote pilot certificate with a small UAS rating. To obtain certification, a person must be at least **16 years** of age. The applicant must also be able to read, speak, write, and understand the English language. If the applicant is unable to meet one of these requirements due to medical reasons, the FAA may place additional operating limitations on that applicant's certificate which would be necessary for the safe operation of the small unmanned aircraft. The applicant must not have any physical or mental conditions that would interfere with the safe operation of a small unmanned aircraft system. Lastly, the applicant must pass an initial aeronautical knowledge test.

There are some exceptions to this last requirement for persons who are already certified pilots. These applicants may either pass an initial aeronautical knowledge test or provide a certificate of completion of a Part 107 initial training course. In this instance, the application must be submitted to the responsible Flight Standards office, a designated pilot examiner, an airman certification representative for a pilot school, a certified flight instructor, or another person authorized by the FAA.

After the FAA accepts an application, they will issue a temporary remote pilot certificate with a small unmanned aircraft system rating. The temporary certificate is good for **120 calendar days**. During this time, the FAA will make the final determination, and either issue a permanent certificate or a notice that the certificate sought is denied or revoked. The temporary certificate expires on the expiration date shown on the certificate, when you receive a permanent certificate, or when you receive a notice of denial. At any time, the holder of a certificate may voluntarily surrender it for cancellation by providing a signed statement to the FAA.

You must notify the FAA if your permanent mailing address changes. You have **30 days** from the change of address to update the information with the FAA. You can inform the FAA by mail or by using the FAA website. If you change your name, you must provide the FAA with a copy of the marriage license, court order, or other document verifying the name change. The FAA will return the documents after inspection.

Drug and Alcohol Offenses

Certain offenses involving drugs or alcohol may result in a denial, a suspension, or a revocation of a remote pilot certificate. Earlier, it was mentioned that transporting illegal substances was a violation of Part 107. If you are caught, the FAA can suspend or revoke your certification. The FAA may also deny, suspend, or revoke your remote pilot certificate if you are convicted for the violation of any Federal or State statute relating to the growing, processing, manufacture, sale, disposition, possession, transportation, or importation of narcotic drugs, marijuana, or depressant or stimulant drugs or substances.

Further, if law enforcement stops you and asks you to submit to a blood-alcohol test, you must not refuse, or the FAA can suspend or revoke your certification or deny your application. You must also provide the results of a blood-alcohol test to the FAA if they request it. When the FAA denies an application for any of the reasons related to drugs or alcohol, a person may not reapply for up to one year after the date of a final conviction.

Aeronautical Knowledge Test

The FAA also requires remote pilots to maintain their certification by re-taking the aeronautical knowledge test. Under Part 107, a person may not operate a small unmanned aircraft system unless that person passed an initial aeronautical knowledge test or passed a recurring aeronautical knowledge test within the previous **24 calendar months**. For certified pilots, this rule applies to an initial or recurrent training course covering the areas of knowledge. The FAA determines who can administer the aeronautical knowledge test, the manner in which the test is given, and the minimum passing grade. To take the test, you must have proper identification, which contains your photograph, signature, date of birth, and permanent mailing address. If you fail the test, you may not reapply for the examination for **14 calendar days**.

It should be obvious, but Part 107 also prohibits cheating on the aeronautical knowledge test. Applicants may not copy or remove the test, give or receive copies of the test, take the test for someone else, or have the test taken for you by someone else. Also, applicants may not assist anyone trying to perform any of these actions. During the exam, applicants are not allowed to use any materials not explicitly authorized by the FAA. Anyone caught cheating on the exam will be unable to apply for any certificate, rating, or authorization for one year after the date of committing the act. They will also be prohibited from taking any tests for one year. Any certificate or rating held by an applicant may be suspended or revoked.

Areas of Knowledge

As mentioned earlier, first-time applicants must pass an initial aeronautical knowledge test, which covers a broad range of topics the FAA wants you to know. The initial aeronautical knowledge test includes the following areas of knowledge:

» Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation
» Airspace classification, operating requirements, and flight restrictions affecting small unmanned aircraft operation
» Aviation weather sources and effects of weather on small unmanned aircraft performance
» Small unmanned aircraft loading
» Emergency procedures
» Crew resource management
» Radio communication procedures
» Determining the performance of small unmanned aircraft
» Physiological effects of drugs and alcohol
» Aeronautical decision-making and judgment
» Airport operations
» Maintenance and preflight inspection procedures

Also mentioned earlier, remote pilots must maintain their certificates by taking a recurrent aeronautical knowledge test every 24 calendar months. This test covers a narrower range of topics than the initial exam. A recurrent aeronautical knowledge test includes the following areas of knowledge:

» Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation
» Airspace classification, operating requirements, and flight restrictions affecting small unmanned aircraft operation
» Emergency procedures
» Crew resource management
» Aeronautical decision-making and judgment
» Airport operations
» Maintenance and preflight inspection procedures

Persons who are already certified pilots have the option to either take an aeronautical knowledge test or provide a certificate of completion of a Part 107 initial training course. The initial training course covers the following areas of knowledge:

- » Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation
- » Effects of weather on small unmanned aircraft performance
- » Small unmanned aircraft loading
- » Emergency procedures
- » Crew resource management
- » Determining the performance of small unmanned aircraft
- » Maintenance and preflight inspection procedures

Persons who are already certified pilots also have the option to take a recurrent training course to maintain certification every 24 calendar months. The recurrent training course covers the following areas of knowledge:

- » Emergency procedures
- » Crew resource management
- » Maintenance and preflight inspection procedures

Waivers

There may be times when a remote pilot wants to conduct commercial operations that fall outside of the limitations set by Part 107. In these circumstances, the remote pilot must apply for a certificate of waiver. The FAA may issue a certificate of waiver authorizing a deviation from any regulation specified in Part 107 if the FAA finds that a proposed small unmanned aircraft operation can safely be conducted under the terms of that certificate of waiver.

A request for a **certificate of waiver** must contain a complete description of the proposed operation and justification that establishes that the operation can safely be conducted. The FAA may prescribe additional limitations that they consider necessary. A remote pilot that receives a certificate of waiver may deviate from the regulations in Part 107 to the extent specified in the certificate of waiver and must comply with any conditions or limitations that are prescribed.

The FAA may issue a certificate of waiver authorizing a deviation from the following Part 107 regulations:

- » 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.
- » Daylight operation
- » 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.
- » Visual observer
- » Operation of multiple small unmanned aircraft systems
- » Yielding the right of way
- » Operation over people.
- » Operation in certain airspace

Operating limitations for small unmanned aircraft

Sample Questions

Readers may locate the answers to the following questions in Appendix A. The sample questions in this book sometimes refer to figures from the ***FAA-CT-8080-2H Airman Knowledge Testing Supplement***. [1]

1001. Which technique should a remote pilot use to scan for traffic? A remote pilot should

A. systematically focus on different segments of the sky for short intervals.

B. concentrate on relative movement detected in the peripheral vision area.

C. continuously scan the sky from right to left.

1002. Under what condition would a small UA not have to be registered before it is operated in the United States?

A. When the aircraft weighs less than .55 pounds on takeoff, including everything that is on-board or attached to the aircraft.

B. When the aircraft has a takeoff weight that is more than .55 pounds, but less than 55 pounds, not including fuel and necessary attachments.

C. All small UAS need to be registered regardless of the weight of the aircraft before, during, or after the flight.

1003. According to 14 CFR part 48, when must a person register a small UA with the Federal Aviation Administration?

A. All civilian small UAs weighing greater than .55 pounds must be registered regardless of its intended use.

B. When the small UA is used for any purpose other than as a model aircraft.

C. Only when the operator will be paid for commercial services.

1004. According to 14 CFR part 48, when would a small UA owner not be permitted to register it?

A. The owner is less than 13 years of age.

B. All persons must register their small UA.

C. If the owner does not have a valid United States driver's license.

1005. According to 14 CFR part 107, what is required to operate a small UA within 30 minutes after official sunset?

A. Use of anti-collision lights.

B. Must be operated in a rural area.

C. Use of a transponder.

1 URL: https://www.amazon.com/FAA-CT-8080-2H-Knowledge-Testing-Supplement-Recreational/dp/1674175949/

1006. To avoid a near midair collision (NMAC) with a manned airplane, you estimate that your small UA climbed to an altitude greater than 6400 feet AGL. To whom must you submit a written report of the deviation?

A. Air Traffic Control.

B. The National Transportation Safety Board.

C. The Federal Aviation Administration, if requested.

1007. Which of the following individuals may process an application for a part 107 remote pilot certificate with an sUAS rating?

A. Remote Pilot in Command.

B. Designated Pilot Examiner.

C. Commercial Balloon pilot.

1008. After receiving a part 107 remote pilot certificate with an sUAS rating, how often must you satisfy recurrent training requirements?

A. Every 6 months.

B. Every 12 months.

C. Every 24 months.

1009. According to 14 CFR part 107, an sUAS is a unmanned aircraft system weighing:

A. 55 kg or less.

B. Less than 55 lbs.

C. 55 lbs or less.

1010. Unmanned aircraft means an aircraft operated:

A. During search and rescue operations other than public.

B. Without the possibility of direct human intervention from within or on the aircraft.

C. For hobby and recreational use when not certificated.

1011. Which of the following types of operations are excluded from the requirements in part 107?

A. Model aircraft for hobby use.

B. UAS used for motion picture filming.

C. Quadcopter capturing aerial imagery for crop monitoring.

1012. Which of the following operations would be regulated by 14 CFR 107?

A. Operating your sUAS for an imagery company.

B. Flying for enjoyment with family and friends.

C. Conducting public operations during a search mission.

1013. A person without a part 107 remote pilot certificate may operate an sUAS for commercial operations:

A. Under the direct supervision of a Remote PIC.

B. Only when visual observers participate in the operation.

C. Alone, if operating during daylight hours.

1014. A person whose sole task is watching the sUAS to report hazards to the rest of the crew is called:

A. Remote PIC.

B. Person manipulating the controls.

C. Visual observer.

1015. Before each flight, the Remote PIC must ensure that:

A. ATC has granted clearance.

B. The site supervisor has approved the flight.

C. Objects carried on the sUAS are secure.

1016. In accordance with 14 CFR part 107, you may operate an sUAS from a moving vehicle when no property is carried for compensation or hire:

A. Over a sparsely populated area.

B. Over suburban areas.

C. Over a parade or other social events.

1017. In accordance with 14 CFR part 107, except when within a 400' radius of a structure, at what maximum altitude can you operate sUAS?

A. 400 feet AGL.

B. 500 feet AGL.

C. 600 feet AGL.

1018. The FAA may approve your application for a waiver of provisions in part 107 only when it has been determined that the proposed operation:

A. Will be conducted outside of the United States.

B. Involves public aircraft or air carrier operations.

C. Can be safely conducted under the terms of that certificate of waiver.

1019. When requesting a waiver, the required documents should be presented to the FAA at least how many days prior to the planned operation?

A. 90 days.

B. 30 days.

C. 10 days.

1020. While operating a small unmanned aircraft system (sUAS), you experience a flyaway, and several people suffer injuries. Which of the following injuries requires reporting to the FAA?

A. An injury requiring an overnight hospital stay.

B. Scrapes and cuts bandaged on site.

C. Minor bruises.

1021. Within how many days must an sUAS accident be reported to the FAA?

A. 10 days.

B. 30 days.

C. 90 days.

1022. While operating your sUAS to do aerial photography, you have a flyaway that causes $700 worth of property damage. Within how many days must you report this accident?

A. You are not required to report this unless requested.

B. 10 days.

C. 30 days.

1023. While operating under Part 107, you crash your sUAS into parking lot lighting, which would cost $300 to repair or $750 to replace. Within how many days must you report this accident?

A. 10 days.

B. 90 days.

C. You are not required to report this accident.

1024. Under Part 107, you must cease operating an sUAS at

A. sunset.

B. the end of evening civil twilight.

C. the beginning of morning civil twilight.

1025. You are inspecting a tower that has a top of 1200 feet AGL. What is the maximum altitude you can fly when operating within 50 feet of this structure?

A. 400 feet AGL.

B. 1200 feet AGL.

C. 1600 feet AGL.

1026. You are approaching an obstacle that is 800 feet above the ground. Under Part 107, can you legally fly over this obstacle?

A. No, you are limited to a maximum altitude of 400 feet AGL.

B. Yes, if you are within 400 feet of the obstacle and fly at or below 1200 feet AGL.

C. Yes, if you stay below 1000 feet AGL.

1027. If a certificated pilot changes permanent mailing address and fails to notify the FAA Airmen Certification Branch of the new address, the pilot is entitled to exercise the privileges of the pilot certificate for a period of only

A. 30 days after the date of the move.

B. 60 days after the date of the move.

C. 90 days after the date of the move.

1028. What effect does haze have on the ability to see traffic or terrain features during flight?

A. Haze causes the eyes to focus at infinity.

B. The eyes tend to overwork in haze and do not detect relative movement easily.

C. All traffic or terrain features appear to be farther away than their actual distance.

1029. The most effective method of scanning for other aircraft for collision avoidance during daylight hours is to use

A. regularly spaced concentration on the 3-, 9-, and 12-o'clock positions.

B. a series of short regularly spaced eye movements to search each 10-degree sector.

C. peripheral vision by scanning small sectors and utilizing off-center viewing.

1030. Most midair collision accidents occur during

A. hazy days.

B. clear days.

C. cloudy nights.

1031. If you bring an sUAS that was registered in another country to operate in the U.S. under Part 107 you must

A. de-register it in that country and register it in the U.S.

B. keep it registered in that country and also register it in the U.S.

C. obtain a Foreign Aircraft Permit.

1032. A flight control failure causes your UAS to collide with the ground without damage to any other property. A report

A. must be made immediately to the NTSB.

B. must be made within 10 days to the FAA.

C. is not required.

1033. A public unmanned aircraft system (UAS)

A. is the only type approved for operations in public locations.

B. is a UAS owned or operated by a federal, state, or local government agency.

C. is never subject to 14 CFR Part 107.

1034. A public UAS

A. is never subject to 14 CFR Part 107.

B. may be operated under either Part 101 or Part 107.

C. must be operated in accordance with Part 107 unless a Certificate of Authorization (COA) is obtained.

1035. To avoid a collision with an unexpectedly large flock of birds, you climb your UAV to 600 feet AGL. A written report

A. would not be required in this case because no deviation from regulations occurred.

B. must be made to the nearest ATC facility.

C. must be submitted to the FAA if requested.

1036. In the event of a near midair collision with an airplane, the UAS PIC

A. is urged to make a report to ATC.

B. is required to make a written report to the NTSB.

C. is required to make a written or online report to the FAA.

1037. A small UA causes an accident, and your crew member loses consciousness. When do you report the accident?

A. No accidents need to be reported.

B. When requested by the UA owner.

C. Within 10 days of the accident.

1038. A small UA must be operated in a manner which

A. does not endanger the life or property of another.

B. requires more than one visual observer.

C. never exceeds 200 feet AGL.

1039. You plan to release golf balls from your small UA at an altitude of 100 feet AGL. You must ensure the objects being dropped will

A. not create an undue hazard to persons or property.

B. land within 10 feet of the expected landing zone.

C. not cause property damage in excess of $300.

1040. During a flight of your small UA, you observe a hot air balloon entering the area. You should

A. yield the right-of-way to the hot air balloon.

B. ensure the UA passes below, above, or ahead of the balloon.

C. expect the hot air balloon to climb above your altitude.

1041. According to 14 CFR part 107, what is the maximum ground speed for a small UA?

A. 87 knots.

B. 87 mph.

C. 100 knots.

1042. (**Refer to Figure 78**.) You have been contracted to inspect towers located approximately 4NM southwest of the Sioux Gateway (SUX) airport operating an unmanned aircraft. What is the maximum altitude above ground level (AGL) that you are authorized to operate over the top of the towers?

A. 400 feet AGL.

B. 402 feet AGL.

C. 802 feet AGL.

1043. Upon request by the FAA, the remote pilot-in-command must provide

A. a logbook documenting small UA landing currency.

B. a remote pilot certificate with a small UAS rating.

C. any employer-issued photo identification.

1044. The refusal of a remote PIC to submit to a blood-alcohol test when requested by a law enforcement officer

A. is grounds for suspension or revocation of their remote pilot certificate.

B. can be delayed for a period up to 8 hours after the request.

C. has no consequences to the remote pilot certificate.

1045. (**Refer to Figure 23**, area 4) What is the required flight visibility for a remote pilot operating an unmanned aircraft near the Plantation Airport (JYL)?

A. 5 statute miles.

B. 1 statute mile.

C. 3 statute miles.

Chapter 2: Aircraft Performance

Before any flight, the remote pilot-in-command (PIC) should verify the aircraft is correctly loaded by determining the weight and balance condition of the aircraft. An aircraft's weight and balance restrictions established by the manufacturer or the builder should be closely followed. Compliance with the manufacturer's weight and balance 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 the 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 small UA operations, weight change during flight may occur when expendable items are used onboard (e.g., a jettisonable load).

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 **center of gravity (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 does not remain within the allowable limits for safe flight, it will be necessary to relocate or shed some weight before the flight is attempted.

Stability

Stability is the inherent quality of an aircraft to correct for conditions that may disturb its **equilibrium** and to return to or to continue on the original flight path. It is primarily an aircraft design characteristic.

Stability in an aircraft affects two areas significantly:

» **Maneuverability**—the quality of an aircraft that permits it to be maneuvered easily and to withstand the stresses imposed by maneuvers. It is governed by the aircraft's weight, inertia, size and location of flight controls, structural strength, and powerplant. It, too is an aircraft design characteristic.

» **Controllability**—the capability of an aircraft to respond to the pilot's control, especially with regard to flight path and attitude. It is the quality of the aircraft's response to the pilot's control application when maneuvering the aircraft, regardless of its stability characteristics.

There are four forces that act on an aircraft during flight [**Figure 2–1**], lift, weight, thrust, and drag. **Lift** is the force that makes the aircraft rise up. The opposite of the lift is the weight. **Weight** is the force of gravity that pulls the aircraft down. **Thrust** is the force that propels the aircraft forward. The opposite of the thrust is the drag. **Drag** is the force that slows the aircraft, such as wind resistance.

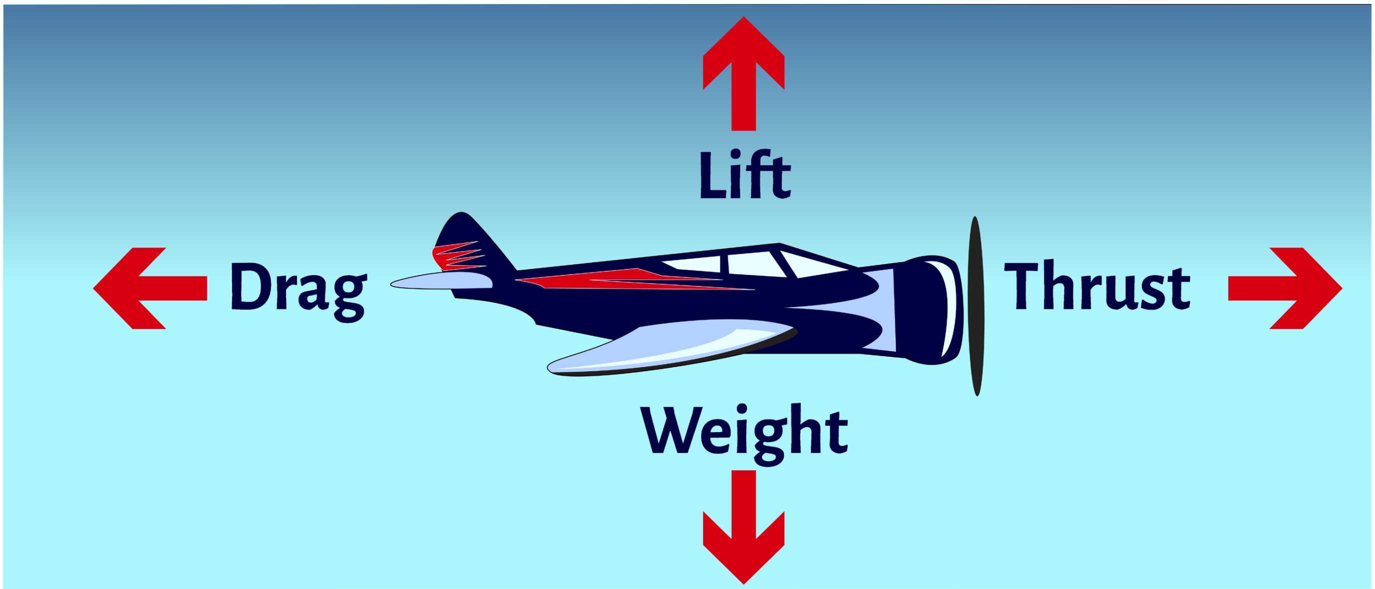


Figure 2–1: The four forces that act on an aircraft during a flight are lift, weight, thrust, and drag.

Unaccelerated flight is defined as straight and level flight where the aircraft is not changing speed or direction. During unaccelerated flight, the four forces are in **equilibrium**. **Lift is equal to weight** and **thrust is equal to drag**.

A fixed-wing aircraft has three axes through which it rotates, which intersect at the center of gravity. Movement around these axes is called pitch, roll, and yaw. [**Figure 2–2**]The vertical axis is a line extending through the aircraft from floor to ceiling. **Yaw** is the movement about the vertical axis, which is controlled by the rudder. One can think of it as the changes in a cardinal direction, such as north, south, east, or west. The lateral axis is a line extending through the aircraft parallel to the wings. **Pitch** is movement around the lateral axis, which is controlled by the elevators. Changes in pitch will bring the nose of the aircraft up or down. The longitudinal axis is a line extending through the aircraft from the nose to the tail. **Roll** is the movement about the longitudinal axis, which is controlled by the ailerons. One can think of it as moving the wing tips up or down.

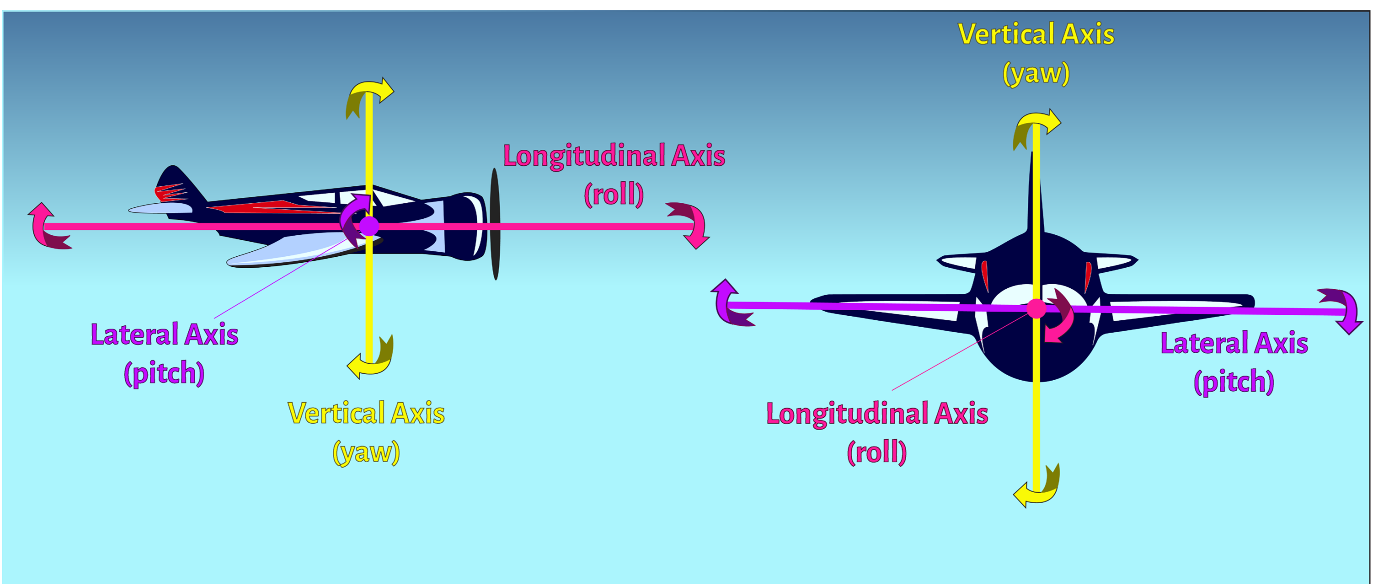


Figure 2–2: A fixed-wing aircraft has three axes through which it rotates.

Weight

Gravity is the pulling force that tends to draw all bodies to the center of the earth. The **center of gravity (CG)** may be considered as a point at which all the weight of the aircraft is concentrated. If the aircraft were supported at its exact CG, it would balance in any attitude. It will be noted that CG is of major importance in a small UA, for its position has a great bearing upon stability. The allowable location of the CG is determined by the general design of each particular aircraft. The designers determine how far the **center of pressure (CP)** will travel. It is important to understand that an aircraft's **weight** is concentrated at the center of gravity (**CG),** and the aerodynamic forces of **lift** occur at the center of pressure (**CP)**. When the CG is forward of the CP, there is a natural tendency for the aircraft to want to pitch nose down. The tail of the aircraft acts like an upside-down wing, pushing the tail-side down and counteracting the center of gravity. [**Figure 2–3**]

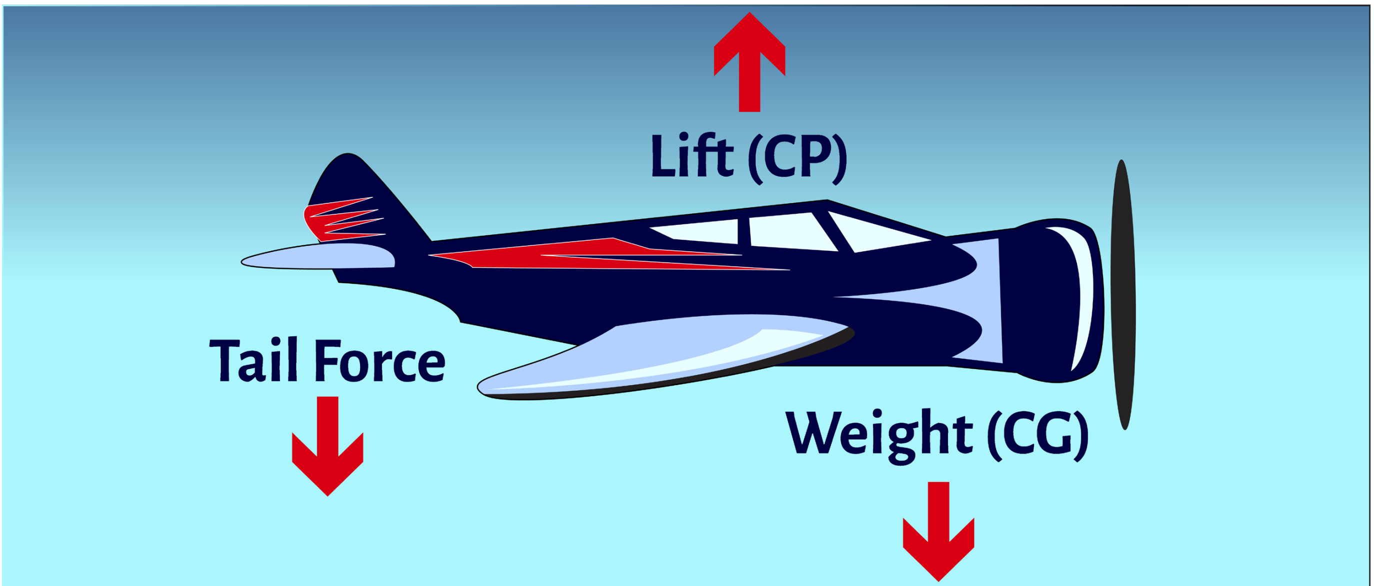


Figure 2–3: In a balanced aircraft, the center of pressure (CP) is aft of the center of gravity (CG)

If the CP is forward of the CG, a nose-up pitching moment is created. [**Figure 2–4**] The aircraft will be unstable at all speeds and will be difficult to recover from a stalled condition. Therefore, designers fix the aft limit of the CG forward of the CP for the corresponding flight speed in order to retain flight equilibrium.

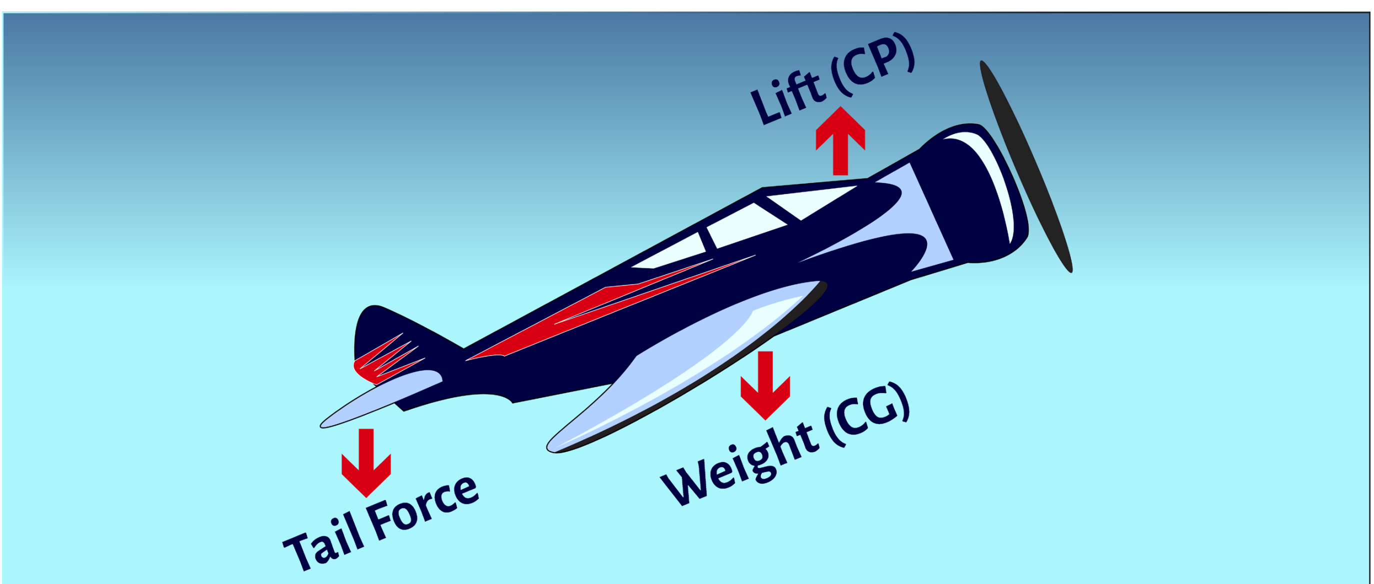


Figure 2–4: If the CG is aft of the CP, the aircraft will be difficult to recover from a stall.

Weight has a definite relationship to lift. This relationship is simple but important in understanding the aerodynamics of flying. Lift is the upward force on the wing acting perpendicular to the relative wind and perpendicular to the aircraft's lateral axis. Lift is required to counteract the aircraft's weight. In stabilized level flight, when the lift force is equal to the weight force, the aircraft is in a state of equilibrium and neither accelerates upward or downward. If the lift becomes less than the weight, the vertical speed will decrease. When the lift is greater than the weight, the vertical speed will increase.

Lift

Aerodynamic lift on a fixed-wing aircraft is based on **Bernoulli's principle** of fluid dynamics. When the speed of a fluid increases, the pressure decreases. The same principle applies to aerodynamics. The curved-shape on the top of the wing of an aircraft causes the airflow to speed up relative to the flat-shaped bottom of the wing. [**Figure 2–5**] As a result, the air pressure across the top of the wing is lower than the air pressure on the bottom of the wing. This imbalance in pressure causes lift.

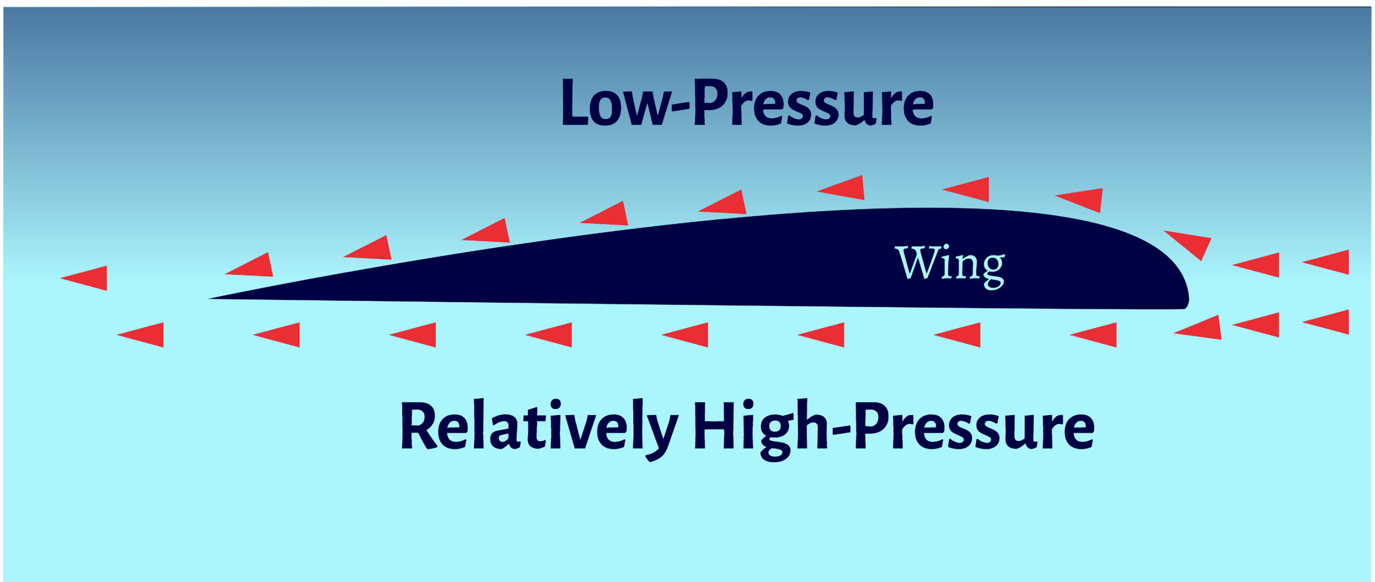


Figure 2–5: The difference in pressure between the top of the wing and the bottom causes lift.

The wind must conform to the shape of the wing for this effect to take place. When the wind does not conform to the shape of the wing, the aircraft may stall. The **angle of attack (AOA)** is defined as the angle between the chord line and the relative wind. [**Figure 2–6**] The threshold for stalling is called the **critical angle of attack**. Exceeding the critical angle of attack will cause the aircraft to stall. [**Figure 2–7**]

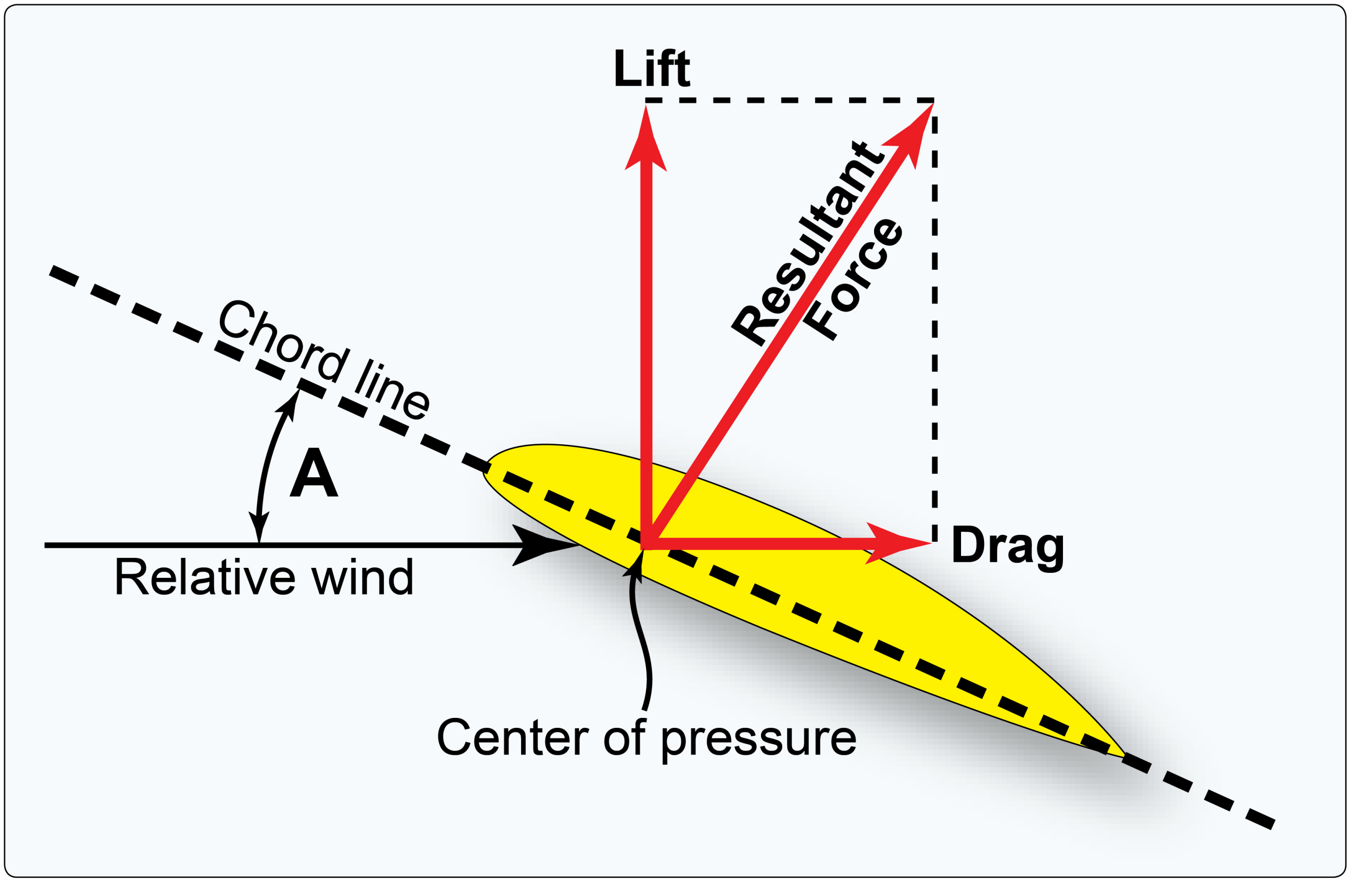


Figure 2–6: The acute angle A is the angle of attack.

Figure 2–7: An aircraft will stall when it exceeds the critical angle of attack.

Load Factors

In aerodynamics, the maximum load factor (at given bank angle) is a proportion between lift and weight and has a trigonometric relationship. The load factor is measured in Gs (acceleration of gravity), a unit of force equal to the force exerted by gravity on a body at rest and indicates the force to which a body is subjected when it is accelerated. Any force applied to an aircraft to deflect its flight from a straight line produces stress on its structure. The amount of this force is the load factor. While a course in aerodynamics is not a prerequisite for obtaining a remote pilot certificate, the competent pilot should have a solid understanding of the forces that act on the aircraft, the advantageous use of these forces, and the operating limitations of the aircraft being flown.

For example, a load factor of 3 means the total load on an aircraft's structure is three times its weight. Since load factors are expressed in terms of Gs, a load factor of 3 may be spoken of as 3 Gs, or a load factor of 4 as 4 Gs.

With the structural design of aircraft planned to withstand only a certain amount of overload, a knowledge of load factors has become essential for all pilots. Load factors are important for two reasons:

1. It is possible for a pilot to impose a dangerous overload on the aircraft structures.
2. An increased load factor increases the stalling speed and makes stalls possible at seemingly safe flight speeds.

Load Factors in Steep Turns

At a constant altitude, during a coordinated turn in any aircraft, the load factor is the result of two forces: centrifugal force and weight. [**Figure 2–8**] For any given bank angle, the rate-of-turn varies with the airspeed—the higher the speed, the slower the rate-of-turn (ROT). This compensates for added centrifugal force, allowing the load factor to remain the same.

Figure 2–9 reveals an important fact about turns—the load factor increases at a terrific rate after a bank has reached **45°**. The load factor for any aircraft in a coordinated level turn at 60° bank is 2 Gs. [**Figure 2–4**] The load factor in an 80° bank is 5.76 Gs. The wing must produce lift equal to these load factors if altitude is to be maintained.

For example, suppose your aircraft weight 4,500 hundred pounds. The aircraft turned at a 60° bank. What is the total load on the wing of the aircraft? Looking at **Figure 2–9**, the load factor at 60° is 2Gs. The total load equals the weight times the load factor. 4,500 hundred pounds multiplied by 2 equals a total load of 9,000 pounds.

It should be noted how rapidly the line denoting load factor rises as it approaches the 90° bank line, which it never quite reaches because a 90° banked, constant altitude turn is not mathematically possible. An aircraft may be banked to 90° in a coordinated turn if not trying to hold altitude. An aircraft that can be held in a 90° banked slipping turn is capable of straight knife-edged flight. At slightly more than 80°, the load factor exceeds the limit of 6 Gs, the limit load factor of an acrobatic aircraft.

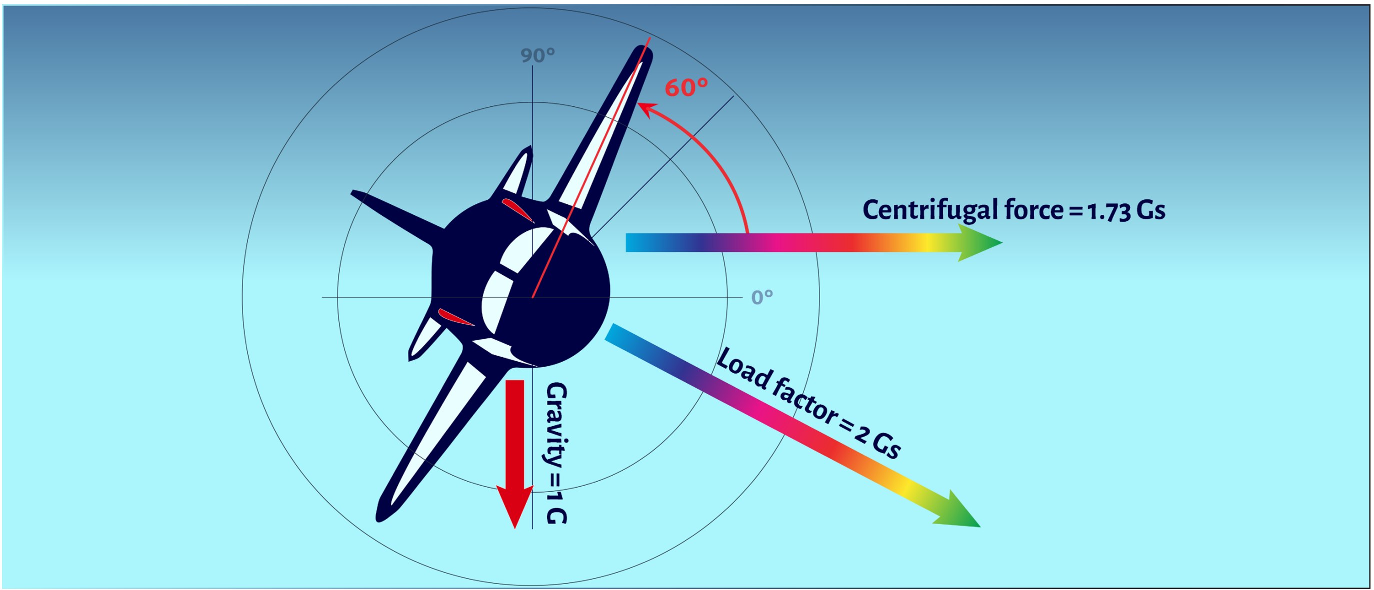


Figure 2–8. Two forces cause load factor during turns.

Angle of bank φ	Load factor n
0°	1.0
10°	1.015
30°	1.154
45°	1.414
60°	2.000
70°	2.923
80°	5.747
85°	11.473
90°	∞

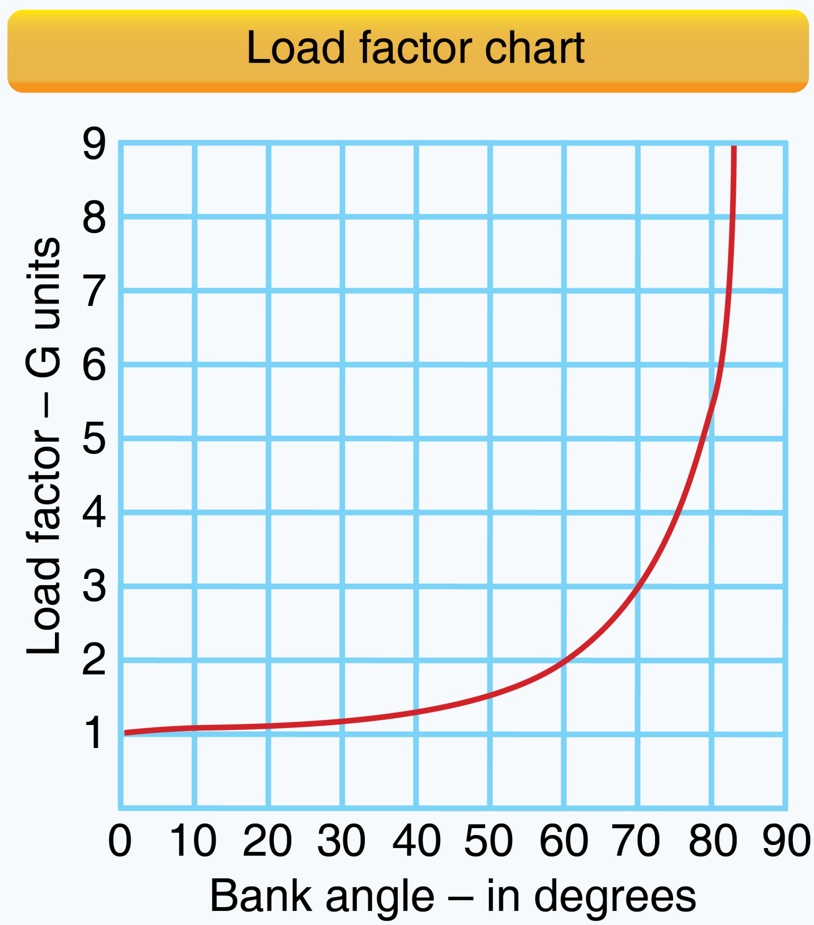


Figure 2–9. The angle of a bank changes the load factor in level flight.

Load Factors and Stalling Speeds

Any aircraft, within the limits of its structure, can be stalled at any airspeed. When a sufficiently high **angle of attack (AOA)** is imposed, exceeding the critical angle of attack, the smooth flow of air over an airfoil breaks up and separates, producing an abrupt change of flight characteristics and a sudden loss of lift, which results in a stall.[**Figure 2–7**] The critical angle of attack remains the same regardless of a change in the gross weight of the aircraft.

A study of this effect has revealed that an aircraft's stalling speed increases in proportion to the square root of the load factor. This means that an aircraft with a normal unaccelerated stalling speed of 50 knots can be stalled at 100 knots by inducing a load factor of 4 Gs. If it were possible for this aircraft to withstand a load factor of nine, it could be stalled at a speed of 150 knots. A pilot should be aware of the danger of inadvertently stalling the aircraft by increasing the load factor, as in a steep turn or spiral.

Figures 2–8 and **2–10** show that banking an aircraft greater than 72° in a steep turn produces a load factor of 3, and the stalling speed is increased significantly. If this turn is made in an aircraft with a normal unaccelerated stalling speed of 45 knots, the airspeed must be kept greater than 75 knots to prevent inducing a stall. A similar effect is experienced in a quick pull up or any maneuver producing load factors above 1 G. This sudden, unexpected loss of control, particularly in a steep turn or abrupt application of the back elevator control near the ground, has caused many accidents.

Since the load factor is squared as the stalling speed doubles, tremendous loads may be imposed on structures by stalling an aircraft at relatively high airspeeds.

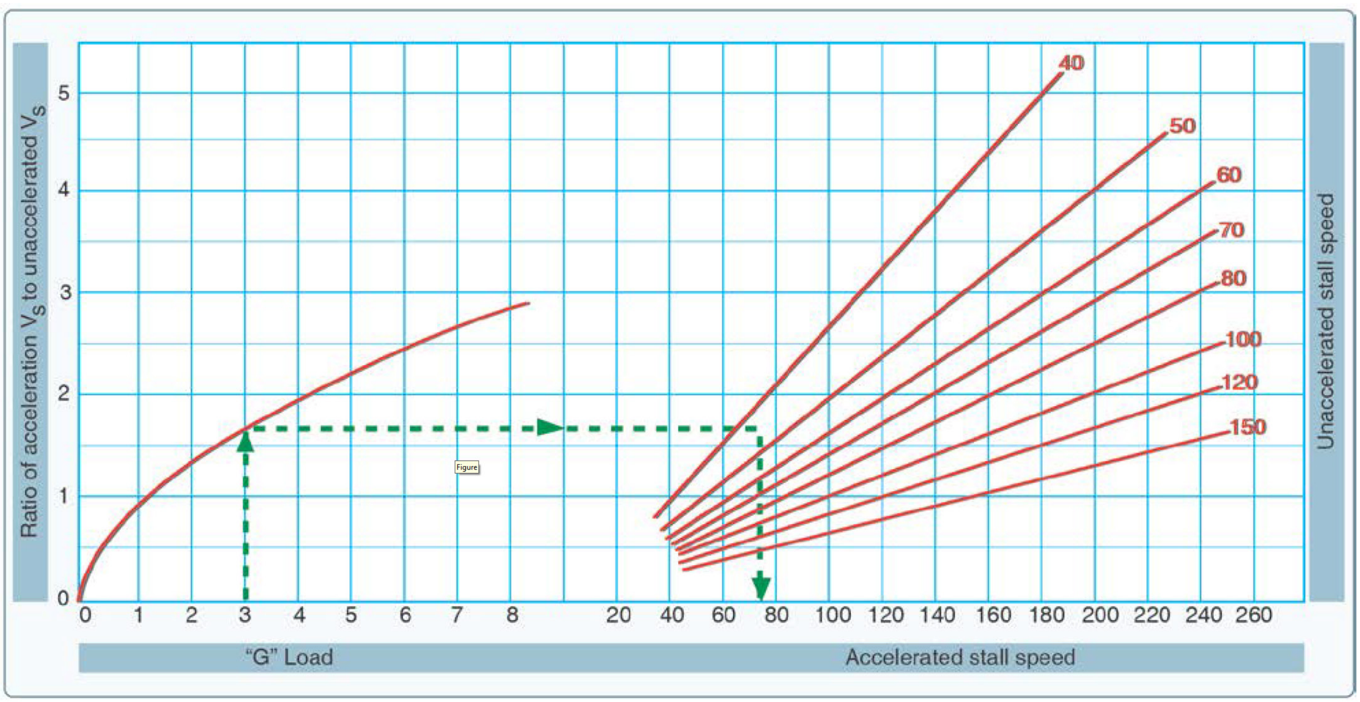


Figure 2–10. The load factor changes stall speed.

Weight and Balance

Compliance with the weight and balance limits of any aircraft is critical to flight safety. Operating above the maximum weight limitation compromises the structural integrity of an aircraft and adversely affects its performance. Operation with the center of gravity (CG) outside the approved limits results in control difficulty. The aircraft's weight and balance data is important information for a pilot that must be frequently reevaluated.

Weight Control

Weight is the force with which gravity attracts a body toward the center of the Earth. It is a product of the mass of a body and the acceleration acting on the body. Weight is a major factor in aircraft construction and operation and demands respect from all pilots. The force of gravity continuously attempts to pull an aircraft down toward Earth. The force of lift is the only force that counteracts weight and sustains an aircraft in flight. The amount of lift produced by an airfoil is limited by the airfoil design, angle of attack, airspeed, and air density. To assure that the lift generated is sufficient to counteract weight, loading an aircraft beyond the manufacturer's recommended weight must be avoided. If the weight is greater than the lift generated, the aircraft may be incapable of flight.

Effects of Weight

Any item aboard an aircraft that increases the total weight is undesirable for performance. Manufacturers attempt to make an aircraft as light as possible without sacrificing strength or safety.

The pilot should always be aware of the consequences of overloading. An overloaded aircraft may not be able to leave the ground, or if it does become airborne, it may exhibit unexpected and unusually poor flight characteristics. If not properly loaded, the initial indication of poor performance usually takes place during takeoff.

Excessive weight reduces flight performance in almost every respect. For example, the most important performance deficiencies of an overloaded aircraft are:

- Higher takeoff speed
- Longer takeoff run
- Reduced rate and angle of climb
- Lower maximum altitude
- Shorter range
- Reduced cruising speed
- Reduced maneuverability
- Higher stalling speed
- Higher approach and landing speed
- Longer landing roll

The pilot must be knowledgeable about the effect of weight on the performance of the particular aircraft being flown. Excessive weight in itself reduces the safety margins available to the pilot and becomes even more hazardous when other performance-reducing factors are combined with excess weight. The pilot must also consider the consequences of an overweight aircraft if an emergency condition arises.

Effects of Weather on Aircraft Performance

Since the characteristics of the atmosphere have a major effect on performance, it is necessary to review two dominant factors—pressure and temperature.

Density Altitude

The more appropriate term for correlating aerodynamic performance in the nonstandard atmosphere is **density altitude**—the altitude in the standard atmosphere corresponding to a particular value of air density. As the density of the air increases (**lower density altitude**), aircraft performance increases. Conversely, as air density decreases (**higher density altitude**), aircraft performance decreases. A *decrease* in air density means a **high-density altitude**; an increase in air density means a lower density altitude. Density altitude has a direct effect on aircraft performance. Air density is affected by changes in altitude, temperature, and humidity. **High-density altitude** refers to **thin air** while low-density altitude refers to dense air. The conditions that result in a high-density altitude are **high elevations**, **low atmospheric pressures**, **high temperatures**, **high humidity**, or some combination of these factors. Lower elevations, high atmospheric pressure, low temperatures, and low humidity are more indicative of low-density altitude.

Effects of Pressure on Density

Since air is a gas, it can be compressed or expanded. When air is compressed, a greater amount of air can occupy a given volume. Conversely, when pressure on a given volume of air is decreased, the air expands and occupies a greater space. That is, the original column of air at a lower pressure contains a smaller mass of air. In other words, the density is decreased. In fact, density is directly proportional to pressure. If the pressure is doubled, the density is doubled, and if the pressure is lowered, so is the density. This statement is true only at a constant temperature.

Effects of Temperature on Density

Increasing the temperature of a substance decreases its density. Conversely, decreasing the temperature increases the density. Thus, the density of air varies inversely with temperature. This statement is true only at a constant pressure. In the atmosphere, both temperature and pressure decrease with altitude and have conflicting effects upon density. However, the fairly rapid drop in pressure as altitude is increased usually has the dominant effect. Hence, pilots can expect the density to decrease with altitude.

Effects of Humidity (Moisture) on Density

The preceding paragraphs are based on the presupposition of perfectly dry air. In reality, it is never completely dry. The small amount of water vapor suspended in the atmosphere may be negligible under certain conditions, but in other conditions, humidity may become an important factor in the performance of an aircraft. Water vapor is lighter than air; consequently, moist air is lighter than dry air. Therefore, as the water content of the air increases, the air becomes less dense, increasing density altitude and decreasing performance. It is lightest or least dense when, in a given set of conditions, it contains the maximum amount of water vapor.

Humidity, also called relative humidity, refers to the amount of water vapor contained in the atmosphere and is expressed as a percentage of the maximum amount of water vapor the air can hold. This amount varies with the temperature; warm air can hold more water vapor, while colder air can hold less. The perfectly dry air that contains no water vapor has a relative humidity of zero percent, while saturated air that cannot hold any more water vapor has a relative humidity of 100 percent. Humidity alone is usually not considered an essential factor in calculating density altitude and aircraft performance; however, it does contribute.

Performance

Performance is a term used to describe the ability of an aircraft to accomplish certain things that make it useful for certain purposes. The primary factors most affected by performance are the takeoff and landing distance, rate of climb, ceiling, payload, range, speed, maneuverability, stability, and fuel economy.

Climb Performance Factors

Since weight, altitude, and configuration changes affect excess thrust and power, they also affect climb performance. Climb performance is directly dependent upon the ability to produce either excess thrust or excess power. Weight has a very pronounced effect on aircraft performance. If weight is added to an aircraft, it must fly at a higher angle of attack (AOA) to maintain a given altitude and speed. This increases the induced drag of the wings, as well as the parasite drag of the aircraft. Increased drag means that additional thrust is needed to overcome it, which in turn means that less reserve thrust is available for climbing. Aircraft designers go to great lengths to minimize the weight since it has such a marked effect on the factors pertaining to performance. A change in an aircraft's weight produces a twofold effect on climb performance. An increase in altitude also increases the power required and decreases the power available. Therefore, the climb performance of an aircraft diminishes with altitude.

Measurement of Atmosphere Pressure

The International Standard Atmosphere (ISA) establishes a common reference. These standard conditions are the basis for most aircraft performance data. **Standard sea-level pressure** is defined as **29.92 "Hg** and a standard temperature of **59 °F (15 °C)**. Atmospheric pressure is also reported in millibars (MB), with 1 "Hg equal to approximately 34 MB. Standard sea-level pressure is **1,013.2 MB**. Typical MB pressure readings range from 950.0 to 1,040.0 MB. Surface charts, high and low-pressure centers, and hurricane data are reported using MB.

Since weather stations are located around the globe, all local barometric pressure readings are converted to sea level pressure to provide a standard for records and reports. To achieve this, each station converts its barometric pressure by adding approximately 1 "Hg for every 1,000 feet of elevation. For example, a station at 5,000 feet above sea level, with a reading of 24.92 "Hg, reports a sea-level pressure reading of 29.92 "Hg.

By tracking barometric pressure trends across a large area, weather forecasters can more accurately predict the movement of pressure systems and the associated weather. For example, tracking a pattern of rising pressure at a single weather station generally indicates the approach of fair weather. Conversely, decreasing or rapidly falling pressure usually indicates approaching bad weather and, possibly, severe storms.

Sample Questions

Readers may locate the answers to the following questions in Appendix A. The sample questions in this book sometimes refer to figures from the ***FAA-CT-8080-2H Airman Knowledge Testing Supplement***. [1]

2001. What effect does high-density altitude have on the efficiency of a UA propeller?

A. Propeller efficiency is increased.

B. Propeller efficiency is decreased.

C. Density altitude does not affect propeller efficiency.

2002. To ensure that the unmanned aircraft center of gravity (CG) limits are not exceeded, follow the aircraft loading instructions specified in the

A. Pilot's Operating Handbook or UAS Flight Manual.

B. Aeronautical Information Manual (AIM).

C. Aircraft Weight and Balance Handbook.

2003. What could be a consequence of operating a small unmanned aircraft above its maximum allowable weight?

A. Shorter endurance.

B. Faster speed.

C. Increased maneuverability.

2004. According to 14 CFR part 107, who is responsible for determining the performance of a small unmanned aircraft?

A. Remote pilot-in-command.

B. Manufacturer.

C. Owner or operator.

2005. When operating an unmanned airplane, the remote pilot should consider that the load factor on the wings may be increased any time

A. the CG is shifted rearward to the aft CG limit.

B. the airplane is subjected to maneuvers other than straight-and-level flight.

C. the gross weight is reduced.

1 URL: https://www.amazon.com/FAA-CT-8080-2H-Knowledge-Testing-Supplement-Recreational/dp/1674175949/

2006. A stall occurs when the smooth airflow over the unmanned airplane's wing is disrupted, and the lift degenerates rapidly. This is caused when the wing

A. exceeds the maximum speed.

B. exceeds maximum allowable operating weight.

C. exceeds its critical angle of attack.

2007. (**Refer to Figure 2**.) If an unmanned airplane weighs 33 pounds, what approximate weight would the airplane structure be required to support during a 30° banked turn while maintaining altitude?

A. 34 pounds.

B. 47 pounds.

C. 38 pounds.

2008. How would high-density altitude affect the performance of a small unmanned aircraft?

A. Increased performance.

B. Decreased performance.

C. No change in performance.

2009. Operating outside of the weight and balance limits of an unmanned aircraft

A. can result in loss of control of the aircraft.

B. increases performance.

C. is not possible per aircraft design.

2010. (**Refer to Figure 2**.) If an unmanned aircraft weighs 20 pounds, what approximate weight would the aircraft structure be required to support during a 60° banked turn while maintaining altitude?

A. 23 pounds.

B. 28 pounds.

C. 40 pounds.

2011. An unmanned aircraft has been loaded in such a manner that the CG is located aft of the aft CG limit. One undesirable flight characteristic a remote pilot might experience with this aircraft would be

A. a longer takeoff run.

B. difficulty in recovering from a stalled condition.

C. stalling at higher-than-normal airspeed.

2012. (**Refer to Figure 2**.) If an unmanned aircraft weighs 45 pounds, what approximate weight would the aircraft structure be required to support during a 45° banked turn while maintaining altitude?

A. 45 pounds.

B. 63 pounds.

C. 72 pounds.

2013. The four forces acting on an airplane in flight are

A. lift, weight, thrust, and drag.

B. lift, weight, gravity, and thrust.

C. lift, gravity, power, and friction.

2014. When are the four forces that act on an airplane in equilibrium?

A. During unaccelerated flight.

B. When the aircraft is accelerating.

C. When the aircraft is at rest on the ground.

2015. (**Refer to Figure 1**.) The acute angle A is the angle of

A. incidence.

B. attack.

C. dihedral.

2016. The term "angle of attack" is defined as the angle between the

A. chord line of the wing and the relative wind.

B. airplanes longitudinal axis and that of the air striking the airfoil.

C. airplane's centerline and the relative wind.

2017. What is the relationship between lift, drag, thrust, and weight when the airplane is in straight-and-level flight?

A. Lift equals weight, and thrust equals drag.

B. Lift, drag, and weight equals thrust.

C. Lift and weight equal thrust and drag.

2018. An airplane said to be inherently stable will

A. be difficult to stall.

B. require less effort to control.

C. not spin.

2019. The amount of excess load that can be imposed on the wing of an airplane depends upon the

A. position of the CG.

B. speed of the airplane.

C. abruptness at which the load is applied.

2020. Which basic flight maneuver increases the load factor on an airplane as compared to straight-and-level flight?

A. Climbs.

B. Turns.

C. Stalls.

2021. What effect does high-density altitude, as compared to low-density altitude, have on propeller efficiency and why?

A. Efficiency is increased due to less friction on the propeller blades.

B. Efficiency is reduced because the propeller exerts less force at high-density altitudes than at low-density altitudes.

C. Efficiency is reduced due to the increased force of the propeller in the thinner air.

2022. What is density altitude?

A. The height above the standard datum plane.

B. The pressure altitude corrected for non-standard temperature.

C. The altitude read directly from the altimeter.

2023. If the outside air temperature (OAT) at a given altitude is warmer than standard, the density altitude is

A. equal to pressure altitude.

B. lower than pressure altitude.

C. higher than pressure altitude.

2024. Which combination of atmospheric conditions will reduce aircraft takeoff and climb performance?

A. Low temperature, low relative humidity, and low-density altitude.

B. High temperature, low relative humidity, and low-density altitude.

C. High temperature, high relative humidity, and high-density altitude.

2025. What effect does high-density altitude have on aircraft performance?

A. It increases engine performance.

B. It reduces climb performance.

C. It increases takeoff performance.

2026. What effect, if any, does high humidity have on aircraft performance?

A. It increases performance.

B. It decreases performance.

C. It has no effect on performance.

2027. The angle of attack at which an airplane wing stalls will

A. increase if the CG is moved forward.

B. change with an increase in gross weight.

C. remain the same regardless of gross weight.

2028. Under which condition will pressure altitude equal true altitude?

A. When the atmospheric pressure is 29.92 inches Hg.

B. When standard atmospheric conditions exist.

C. When indicated, altitude is equal to the pressure altitude.

2029. Under what condition is pressure altitude and density altitude the same value?

A. At sea level, when the temperature is 0 °F.

B. When the altimeter has no installation error.

C. At standard temperature.

2030. Which factor would tend to increase the density altitude at a given airport?

A. An increase in barometric pressure.

B. An increase in ambient temperature.

C. A decrease in relative humidity.

2031. Which statement relates to Bernoulli's principle?

A. For every action, there is an equal and opposite reaction.

B. An additional upward force is generated as the lower surface of the wing deflects air downward.

C. Air traveling faster over the curved upper surface of an airfoil causes lower pressure on the top surface.

2032. The angle between the chord line of an airfoil and the relative wind is known as the angle of

A. lift.

B. attack.

C. incidence.

2033. Changes in the center of pressure of a wing affect the aircraft's

A. lift/drag ratio.

B. lifting capacity.

C. aerodynamic balance and controllability.

2034. At what bank angle for a turn does the additional force on the wings become significant?

A. 15 degrees.

B. 30 degrees.

C. 45 degrees.

Chapter 3: The National Airspace System

Many readers of this book may not realize that each time they fly a drone, they become participants of the National Airspace System. According to the FAA, the **National Airspace System** is a common network of the United States airspace; its navigation facilities, equipment and services, airports or landing areas; aeronautical charts, information and services; rules, regulations and procedures, technical information, and manpower and material. Included are system components shared jointly with the military. Both Part 107 and the remote pilot certificate with a small unmanned aircraft rating are designed to integrate non-recreational drones into the National Airspace System.

Types of Airports

The definition for **airports** refers to any area of land or water used or intended for landing or takeoff of aircraft. This includes, within the five categories of airports listed below, special types of facilities including seaplane bases, heliports, and facilities to accommodate tilt-rotor aircraft. An airport includes an area used or intended for airport buildings, facilities, as well as the rights-of-way, together with the buildings and facilities.

There are two types of airports—**towered** and **non-towered**. These types can be further subdivided to:

» **Civil Airports**—airports that are open to the general public.

» **Military/Federal Government airports**—airports operated by the military, National Aeronautics and Space Administration (NASA), or other agencies of the Federal Government.

» **Private Airports**—airports designated for private or restricted use only, not open to the general public.

Towered Airport

A **towered airport** has an operating control tower. **Air traffic control (ATC)** is responsible for providing the safe, orderly, and expeditious flow of air traffic at airports where the type of operations and/or volume of traffic requires such a service.

Non-towered Airport

A **non-towered airport** does not have an operating control tower. Two-way radio communications are not required, although it is a good operating practice for pilots to monitor other aircraft on the specified frequency for the benefit of other traffic in the area. The key to monitoring traffic at an airport without an operating control tower is the selection of the correct common frequency. The acronym **CTAF**, which stands for **Common Traffic Advisory Frequency**, is synonymous with this program. A **CTAF** is a frequency designated for the purpose of carrying out airport advisory practices while operating to or from an airport without an operating control tower. The CTAF may be a Universal Integrated Community (UNICOM), MULTICOM, FSS, or tower frequency and is identified in appropriate aeronautical publications. **UNICOM** is a nongovernment air/ground radio communication station that may provide airport information at public-use airports where there is no tower or FSS.

Non-towered airport traffic patterns are always entered at **pattern altitude**. How you enter the pattern depends upon the direction of arrival. The preferred method for entering from the downwind side of the pattern is to approach the pattern on a course **45 degrees to the downwind leg** and join the pattern at **midfield**.

Identifying Airports on a Sectional Chart

The FAA wants remote pilots to be able to recognize airports on a sectional chart. Airports may be shown in a variety of ways that indicate if the type of airport, the orientation of hard-surface runways, and whether it is towered or non-towered. Sectional charts provide some additional information as well, including radio frequencies, lighting, and elevation.

The basic symbol of an airport is a circle. Sometimes the circle will contain the letter R, which indicates a private airport. [**Figure 3–1**]. Near to the airport symbol, readers should see the name of the airport and the CTAF frequency.

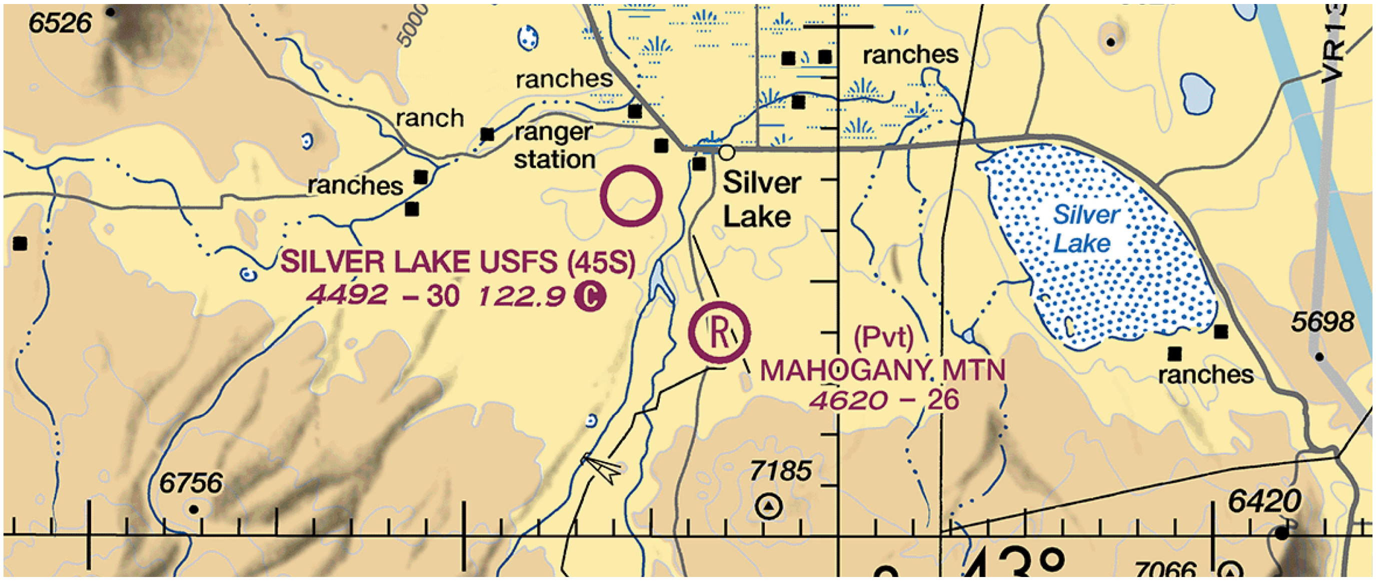


Figure 3–1: This sectional chart represents Silver Lake USFS (45S) using a magenta circle. The CTAF radio frequency for this airport is 122.9, indicated with a small solid-filled circle with the letter C inside. The sectional chart represents the private airport, Mahogany MTN using a circle with the letter R inside.

Another symbol for airports is a circle with a solid fill color and one or more clear lines that represent a **hard surface runway** at least **1,500 feet** in length. The lines also indicate the approximate length and general orientation of the runways. [**Figure 3–2**] The **magenta** color of the airport symbol indicates that it is a **non-towered** airport.

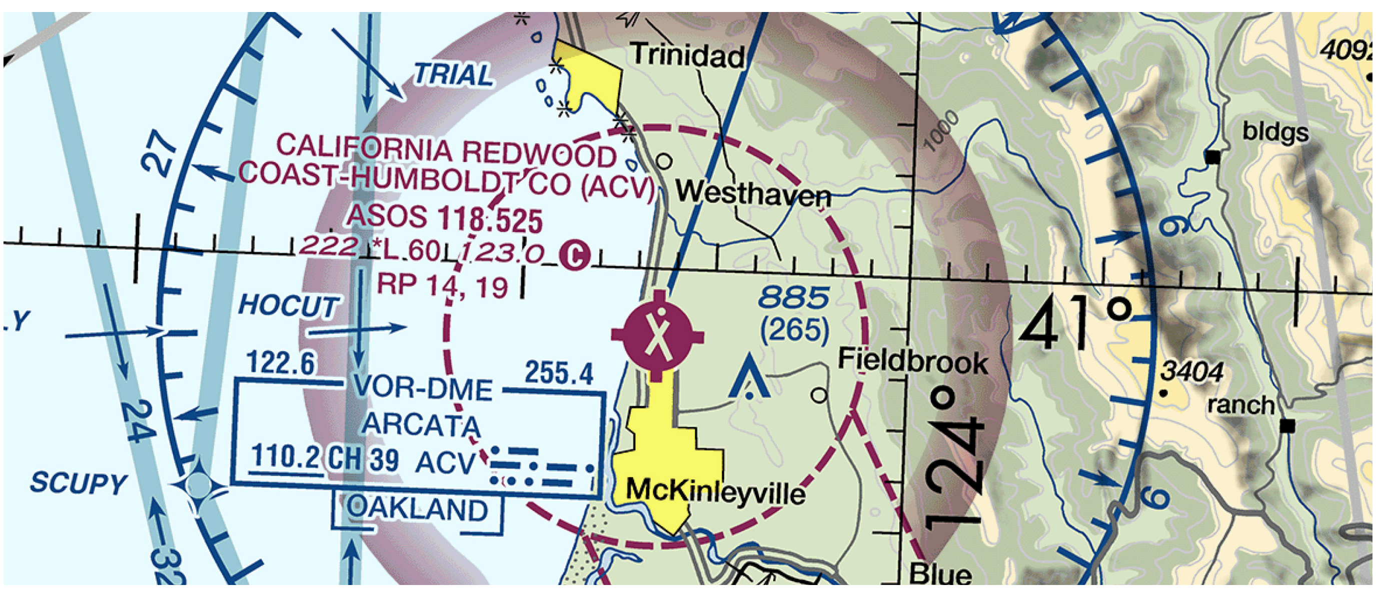


Figure 3–2: The sectional chart shows California Redwood Coast-Humboldt CO (ACV) with the general orientation of the runway. The magenta color indicates that this is a non-towered airport.

Aeronautical sectional charts represent **towered** airports using a **blue** symbol. [**Figure 3–3**] Larger airports may only have the runway symbols instead of the combination of a circle and runway. Close to the name of the airport, the letters CT indicate the control tower frequency. If the control tower is not operational 24-hours a day, a star symbol follows the control tower frequency. When the tower is not operational, the CTAF frequency is followed by a small solid-filled circle with the letter C inside.

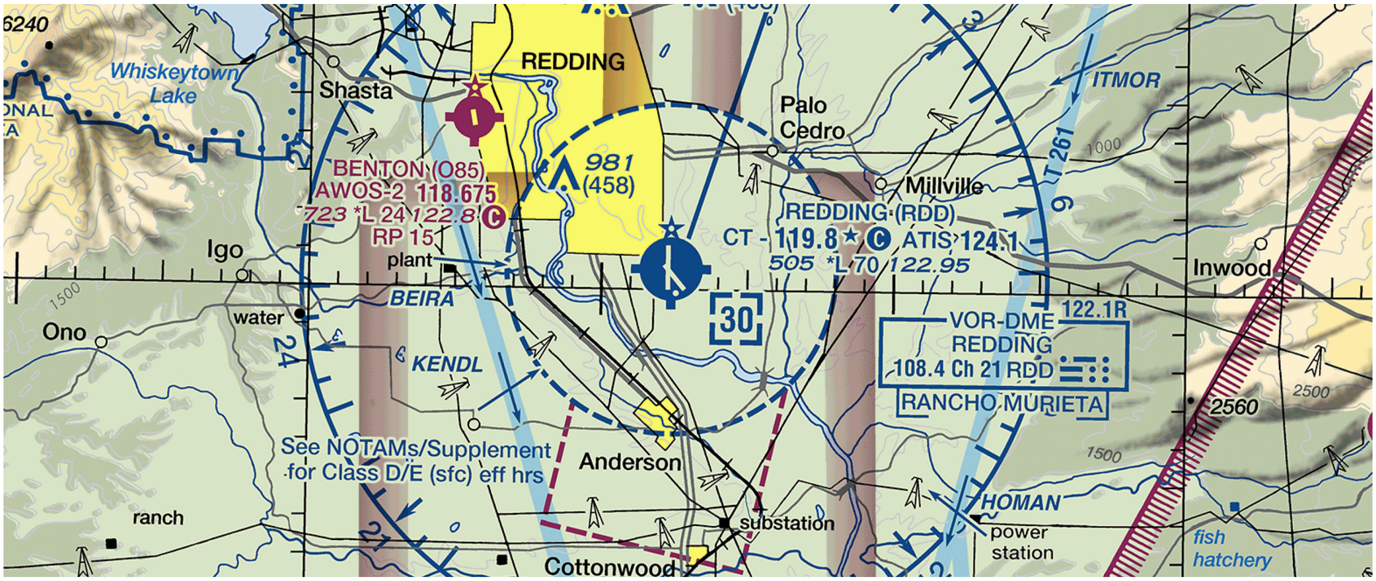


Figure 3–3: The sectional chart shows Redding (RDD) airport. The blue color indicates that this is a towered airport. The control tower frequency is 119.8. The star following the frequency indicates that the control tower is not continuously operated. The solid-filled circle with the letter C inside indicates that when the tower is non-operational, the CTAF frequency is also 119.8.

After the radiofrequency information, the aeronautical sectional chart also indicates the elevation (in feet) of the airport above the **mean sea level (MSL)**. [**Figure 3–4**] Following the elevation, the letter L indicates that the airport has lights. If an asterisk precedes the letter L, then there is some additional information about the lights located in the Chart Supplement, such as the hours of operations. Following the lighting information is the length (in feet) of the longest hard surface runway. The number is abbreviated, so readers must add two zeros to the end of the number.

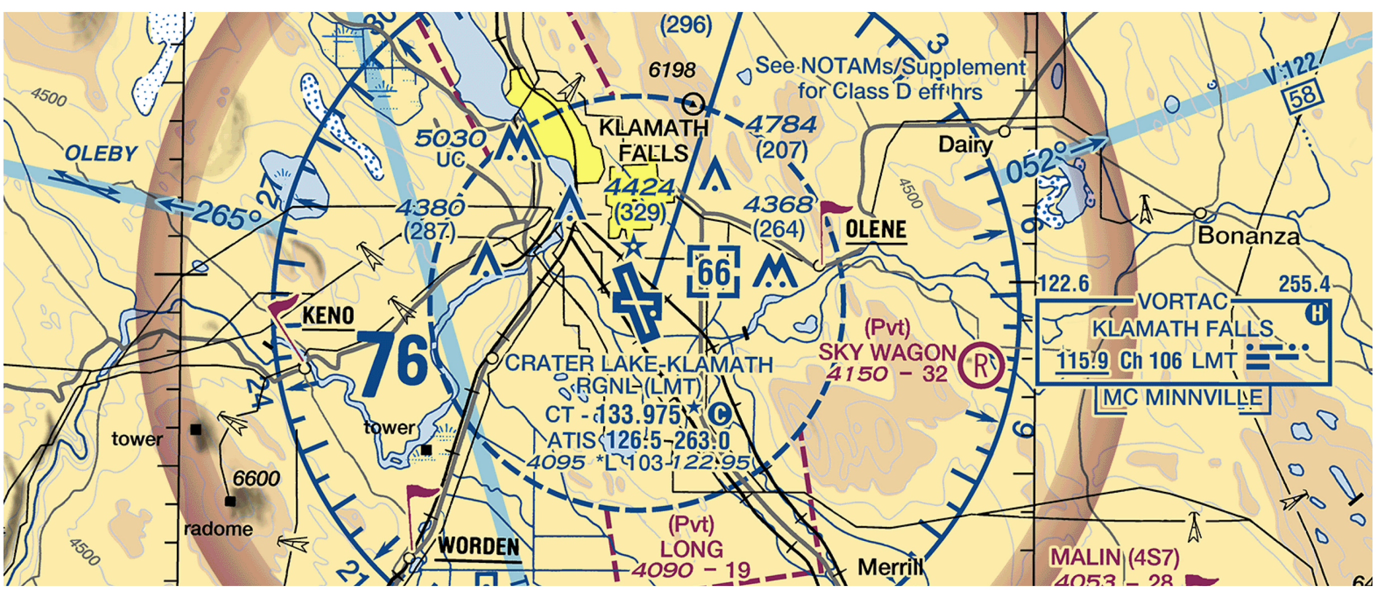


Figure 3–4: This sectional chart shows Crater Lake Klamath RGNL (LMT). The airport elevation is 4,095 feet MSL. It has lights, though they may not be operational all of the time. The longest hard-surface runway is 10,300 feet.

VFR Check Points for Manned Aircraft

The FAA wants remote pilots to be able to identify VFR checkpoints on an aeronautical sectional chart. A VFR checkpoint is a non-mandatory visual reporting checkpoint for pilots to use when identifying their location during an approach to an airport. On a sectional chart, a VFR checkpoint is shown as a flag symbol. [**Figure 3–5**]

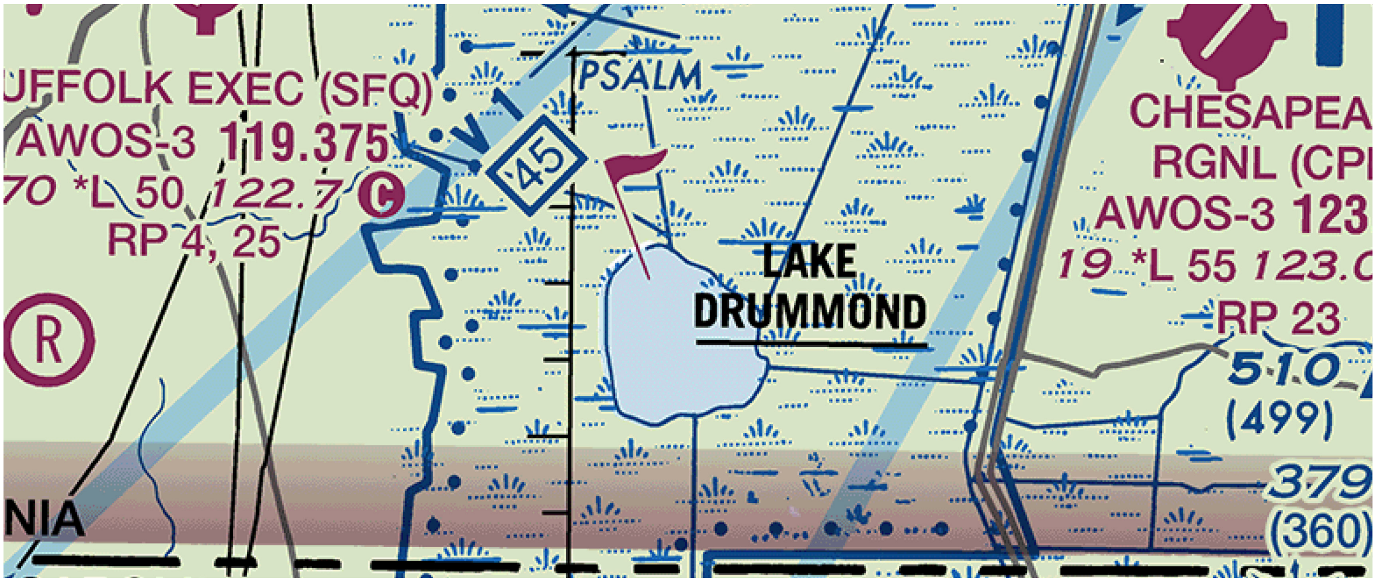


Figure 3–5: The flag symbol over Lake Drummond indicates a voluntary visual checkpoint for pilots on approach to Norfolk INTL (ORF).

Sources for Airport Data

When a remote pilot operates in the vicinity of an airport, it is important to review the current data for that airport. This data provides the pilot with information, such as communication frequencies, services available, closed runways, or airport construction. Three common sources of information are:

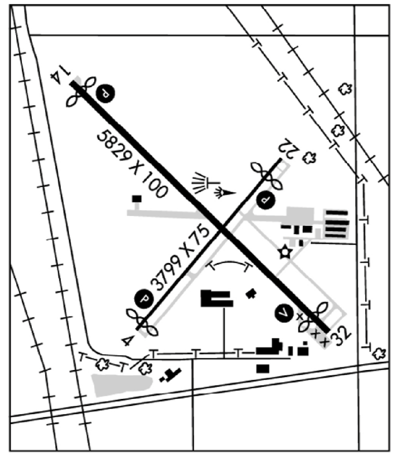
- Aeronautical Charts
- Chart Supplement U.S. (formerly Airport/Facility Directory)
- Notices to Airmen (NOTAMs)
- Automated Terminal Information Service (ATIS)

Chart Supplement U.S. (formerly Airport/Facility Directory)

The **Chart Supplement U.S.** (formerly Airport/Facility Directory) provides the most comprehensive information on a given airport. It contains information on airports, heliports, and seaplane bases that are open to the public. The Chart Supplement U.S. is published in seven books, which are organized by regions and are revised every 56 days. The Chart Supplement U.S. is also available digitally at *www.faa.gov/air_traffic/flight_info/aeronav*. **Figure 3–6** contains an excerpt from a directory. For a complete listing of information provided in a Chart Supplement U.S. and how the information may be decoded, refer to the "Legend Sample" located in the front of each Chart Supplement U.S.

TOLEDO

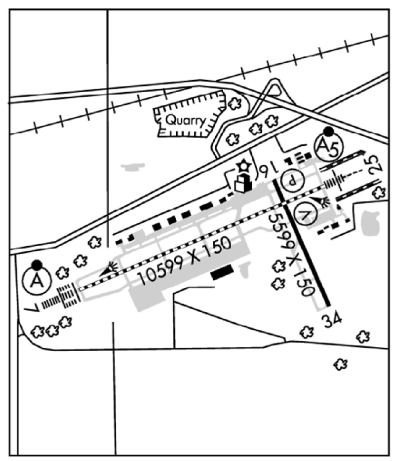
TOLEDO EXECUTIVE (TDZ) 6 SE UTC–5(–4DT) N41°33.90′ W83°28.93′ **DETROIT**
623 B S4 **FUEL** 100LL, JET A OX 1, 3 NOTAM FILE TDZ **H–10G, L–28J**
RWY 14–32: H5829X100 (ASPH–GRVD) S–63, D–85, 2S–107 MIRL **IAP**
RWY 14: REIL. PAPI(P4L)—GA 3.0° TCH 34′. Thld dsplcd 225′. Tower.
RWY 32: VASI(V4L)—GA 3.0° TCH 43′. Thld dsplcd 351′. Road.
RWY 04–22: H3799X75 (ASPH) S–63, D–85, 2S–107 MIRL
RWY 04: REIL. PAPI(P4L)—GA 3.5° TCH 35′. Thld dsplcd 100′. Road.
RWY 22: REIL. PAPI(P4L)—GA 3.0° TCH 25′. Thld dsplcd 380′. Railroad.
AIRPORT REMARKS: Attended Mon–Fri continuously, Sat–Sun 1300–0100Z‡. Parallel twy Rwy 04–22 and Rwy 14–32 35′ wide. Seagulls on and invof arpt. Ldg fee. ACTIVATE MIRL Rwy 04–22 and Rwy 14–32, REIL and PAPI Rwy 04, Rwy 22, Rwy 14 and VASI Rwy 32—CTAF.
WEATHER DATA SOURCES: ASOS 121.575 (419) 838–5034.
COMMUNICATIONS: CTAF/UNICOM 123.05
Ⓡ **APP/DEP CON** 126.1 **CLNC DEL** 125.6
RADIO AIDS TO NAVIGATION: NOTAM FILE CLE.
WATERVILLE (L) VOR/DME 113.1 VWV Chan 78 N41°27.09′ W83°38.32′ 048° 9.8 NM to fld. 664/2W.



TOLEDO EXPRESS (TOL) 10 W UTC–5(–4DT) N41°35.21′ W83°48.47′ **DETROIT**
683 B S4 **FUEL** 100LL, JET A OX 3 LRA Class I, ARFF Index B NOTAM FILE TOL **H–10G, L–28J**
RWY 07–25: H10599X150 (ASPH–GRVD) S–100, D–174, 2S–175, 2D–300, 2D/2D2–550 **IAP, AD**
HIRL CL
RWY 07: ALSF2. TDZL. Trees.
RWY 25: MALSR. VASI(V4L)—GA 3.0° TCH 51′. Trees. 0.3% up.
RWY 16–34: H5599X150 (ASPH–GRVD) S–100, D–174, 2S–175, 2D–300 MIRL
RWY 16: REIL. PAPI(P4L)—GA 3.0° TCH 48′. Trees.
RWY 34: REIL.
RUNWAY DECLARED DISTANCE INFORMATION

RWY 07:	TORA 10599	TODA 10599	ASDA 10599	LDA 10599
RWY 16:	TORA 5599	TODA 5599	ASDA 5599	LDA 5599
RWY 25:	TORA 10599	TODA 10599	ASDA 10599	LDA 10599
RWY 34:	TORA 5599	TODA 5599	ASDA 5599	LDA 5599

ARRESTING GEAR/SYSTEM
RWY 07 ←BAK–12 BAK–12 →**RWY 25**
AIRPORT REMARKS: Attended continuously. Fuel and svc avbl 1300–0500Z‡. Birds on and invof arpt. Twy A west of Rwy 16 and the ramp between Twy B9 and B13 not visible from twr. Twy D intersection of Twy D1, heavy acft use minimal power to reduce foreign object damage on Air National Guard ramp. Customs: Sat–Sun req must be made prior to 2200Z‡ on Fri, phone 419–259–6424.
WEATHER DATA SOURCES: ASOS (419) 865–8351.
COMMUNICATIONS: ATIS 118.75 **UNICOM** 122.95
Ⓡ **APP/DEP CON** 126.1 (360°–179°) 134.35 (180°–359°) 123.975
TOWER 118.1 **GND CON** 121.9 **CLNC DEL** 121.75
AIRSPACE: CLASS C svc continuous ctc **APP CON**
RADIO AIDS TO NAVIGATION: NOTAM FILE CLE.
WATERVILLE (L) VOR/DME 113.1 VWV Chan 78 N41°27.09′ W83°38.32′ 319° 11.1 NM to fld. 664/2W.
TOPHR NDB (LOM) 219 TO N41°33.21′ W83°55.27′ 074° 5.5 NM to fld. Unmonitored. NOTAM FILE TOL.
ILS 109.7. I–TOL Rwy 07. Class IE. LOM TOPHR NDB.
ILS 108.7 I–BQE Rwy 25. Class IA. LOC unusable 0.4 NM inbound. ILS unmonitored when twr clsd.
ASR



SEAGATE HELISTOP (6T2) 00 N UTC–5(–4DT) N41°39.25′ W83°31.88′ **DETROIT**
650 NOTAM FILE CLE
HELIPAD H1: H50X50 (CONC)
HELIPORT REMARKS: Unattended. ACTIVATE orange perimeter lgts—CTAF. Helipad H1 NSTD 1–box (2 VASIS). Helipad H1 not marked with ''H.'' Helipad H1 perimeter lgts.
COMMUNICATIONS: CTAF/UNICOM 123.05

Figure 3–6: Chart Supplement U.S. (formerly Airport/Facility Directory excerpt.

Notices to Airmen (NOTAMs)

Notices to Airmen, or **NOTAMs**, are time-critical aeronautical information either temporary in nature or not sufficiently known in advance to permit publication on aeronautical charts or in other operational publications. The information receives immediate dissemination via the National Notice to Airmen (NOTAM) System. NOTAMs contain current notices to airmen that are considered essential to the safety of flight, as well as supplemental data affecting other operational publications. There are many different reasons that NOTAMs are issued. Following are some of those reasons:

» Hazards, such as air shows, parachute jumps, kite flying, and rocket launches

» Flights by important people such as heads of state

» Inoperable lights on tall obstructions

» Temporary erection of obstacles near airfields

» Passage of flocks of birds through airspace (a NOTAM in this category is known as a BIRDTAM)

The NOTAM information could affect your decision to make the flight. Although NOTAMs contain information such as taxiway and runway closures, construction, communications, changes in status of navigational aids, and other information essential to planned en route, terminal, or landing operations, a remote pilot can use this information to help them make an informed decision about where and when to operate their small UA. Exercise good judgment and common sense by carefully regarding the information readily available in NOTAMs.

Prior to any flight, pilots should check for any NOTAMs that could affect their intended flight. NOTAMs are available in printed form through subscription from the Superintendent of Documents or online at ***PilotWeb***[1], which provides access to current NOTAM information. Local airport NOTAMs can be obtained online from various websites. Some examples are ***www.fltplan.com*** and ***www.aopa.org/whatsnew/notams.html***. Most sites require free registration and acceptance of terms but offer pilots updated NOTAMs and TFRs.

Automated Terminal Information Service (ATIS)

The **Automated Terminal Information Service (ATIS)** is a recording of the local weather conditions and other pertinent non-control information broadcast on a local frequency in a looped format. It is normally updated once per hour but is updated more often when changing local conditions warrant. Important information is broadcast on ATIS, including weather, runways in use, specific ATC procedures, and any airport construction activity that could affect taxi planning. When the ATIS is recorded, it is given a code. This code is changed with every ATIS update. For example, ATIS Alpha is replaced by ATIS Bravo. The next hour, ATIS Charlie is recorded, followed by ATIS Delta and progresses down the alphabet.

Aeronautical Charts

An **aeronautical chart** is the road map for a pilot. The chart provides information that allows remote pilots to obtain information about the areas where they intend to operate. The two aeronautical charts used by visual flight rules (VFR) pilots are:

» Sectional

» VFR Terminal Area

A free catalog listing aeronautical charts and related publications, including prices and instructions for ordering, is available at the Aeronautical Navigation Products website: www.aeronav.faa.gov.

1 URL: https://pilotweb.nas.faa.gov/PilotWeb/

Sectional Charts

Sectional charts are the most common charts used by pilots today. The charts have a scale of 1:500,000 (1 inch = 6.86 nautical miles (NM) or approximately 8 statute miles (SM)), which allows for more detailed information to be included on the chart.

The charts provide an abundance of information, including airport data, navigational aids, airspace, and topography. **Figure 3–7** is an excerpt from the legend of a sectional chart. By referring to the chart legend, a pilot can interpret most of the information on the chart. A pilot should also check the chart for other legend information, which includes air traffic control (ATC) frequencies and information on airspace. These charts are revised semiannually except for some areas outside the conterminous United States, where they get revised annually.

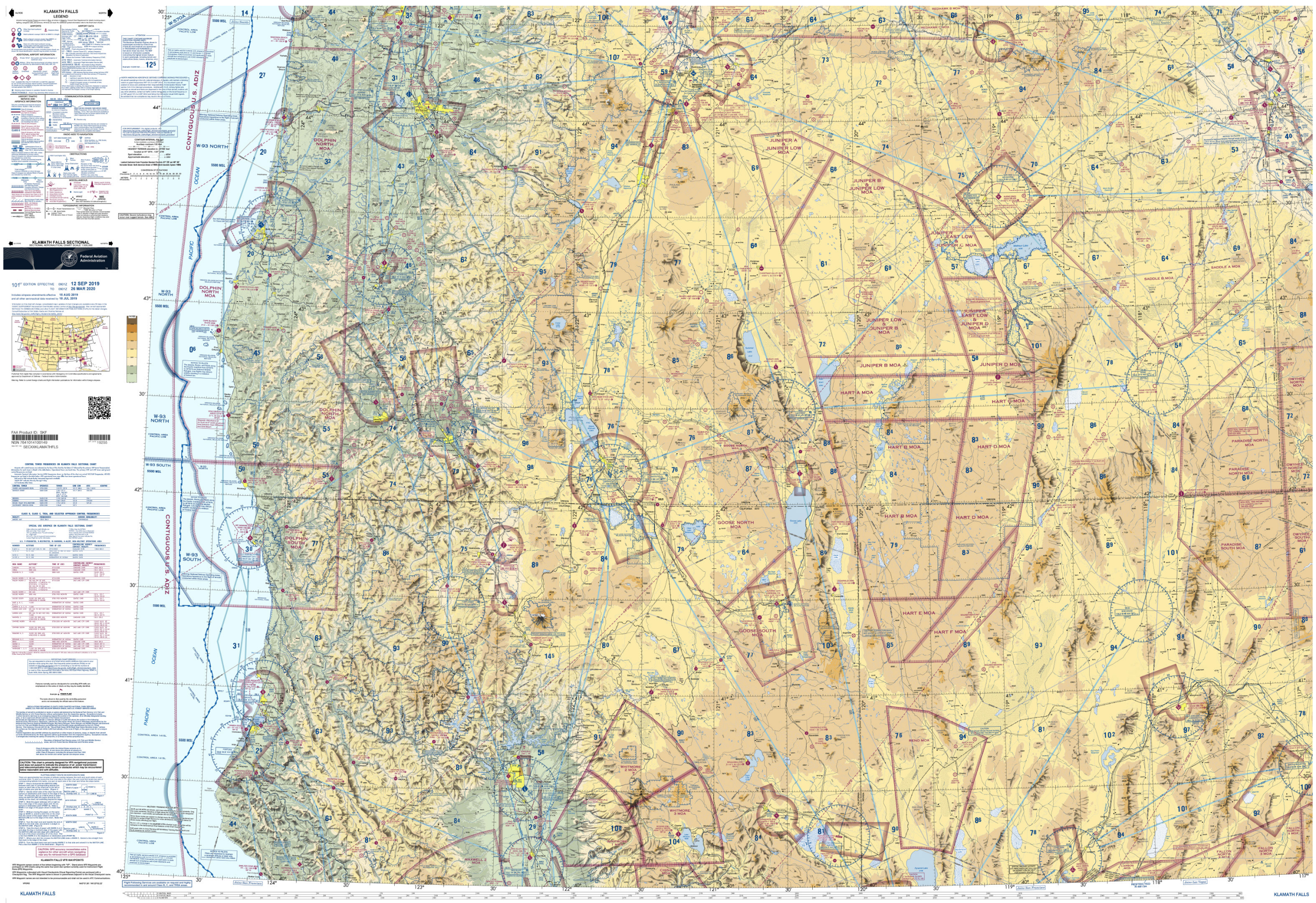


Figure 3–7: Sectional chart and legend.

Latitude and Longitude (Meridians and Parallels)

The equator is an imaginary circle equidistant from the poles of the Earth. Circles parallel to the equator (lines running east and west) are parallels of latitude. [**Figure 3–8**] They are used to measure degrees of latitude north (N) or south (S) of the equator. The angular distance from the equator to the pole is one-fourth of a circle or 90°. The 48 conterminous states of the United States are located between 25° and 49° N latitude.

Meridians of longitude are drawn from the North Pole to the South Pole and are at right angles to the Equator. [**Figure 3–9**] The "Prime Meridian," which passes through Greenwich, England, is used as the zero line from which measurements are made in degrees east (E) and west (W) to 180°. The 48 conterminous states of the United States are between 67° and 125° W longitude.

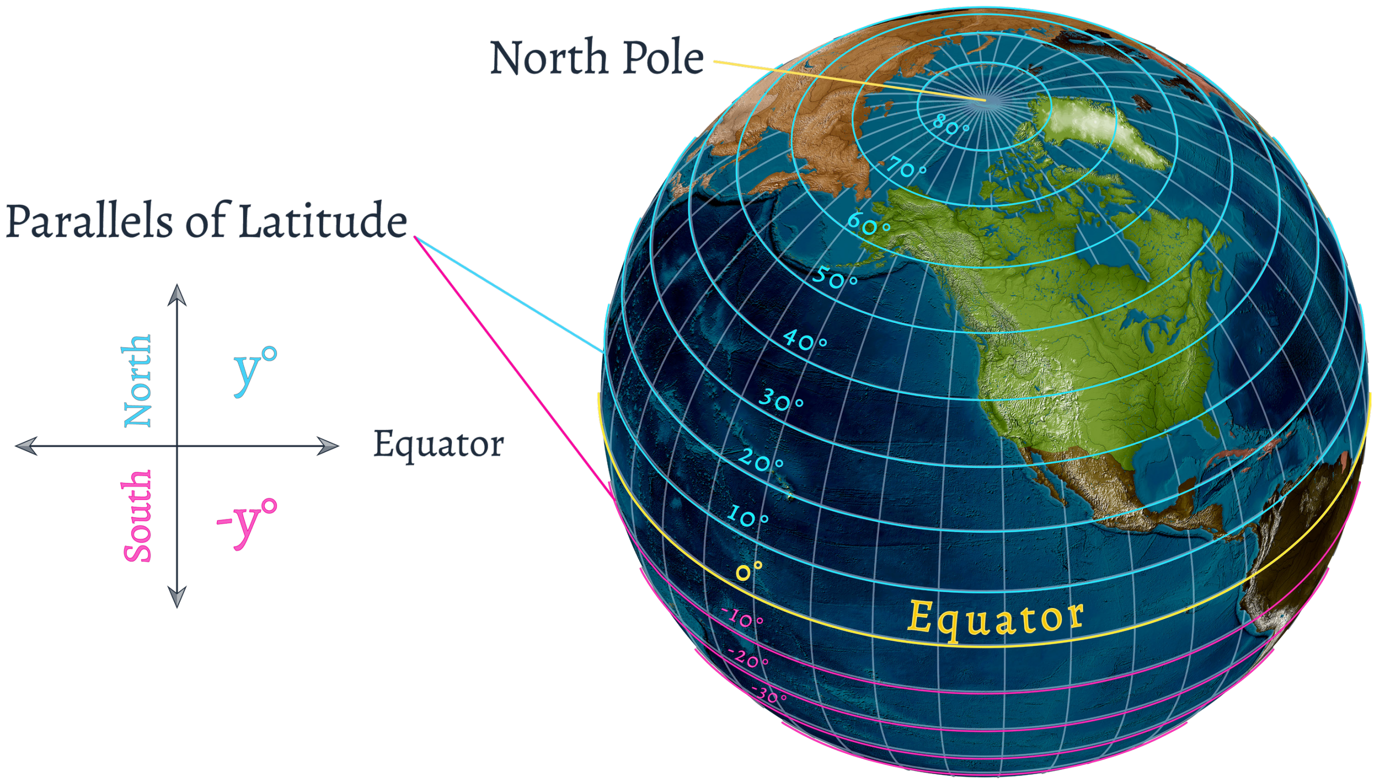


Figure 3–8: The blue lines represent north latitude while the pink lines represent south latitude. One expresses south latitude as a negative number.

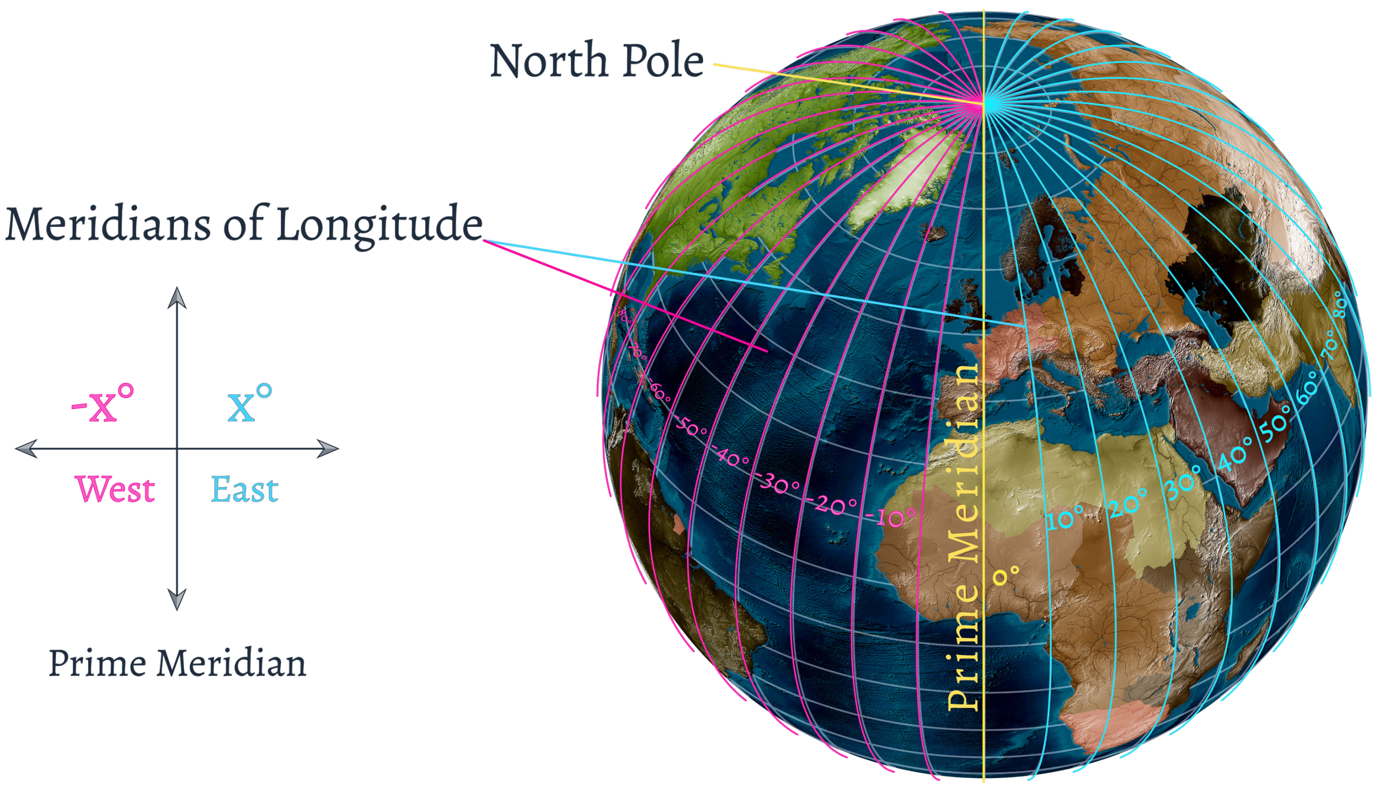


Figure 3–9: The blue lines represent east longitude while the pink lines represent west longitude. One expresses west longitude as a negative number.

Any specific geographical point can be located by reference to its longitude and latitude. Washington, D.C., for example, is approximately 39° N latitude, 77° W longitude. Chicago is approximately 42° N latitude, 88° W longitude.

Latitude and longitude, sometimes referred to as **geographic coordinates**, are traditionally written using degrees minutes seconds (DMS) notation: dd° mm' ss" N or S, ddd° mm' ss" E or W. Using this notation, dd° is the number of whole degrees, mm' is the number of minutes, and ss" is the number of seconds. The letter N for locations north of the equator or the letter S for locations south of the equator follows the degrees minutes and seconds of latitude. The letter W for locations west of the Prime Meridian or the letter E for locations east of the Prime Meridian follows the degrees minutes and seconds of longitude. [**Figure 3–10**]

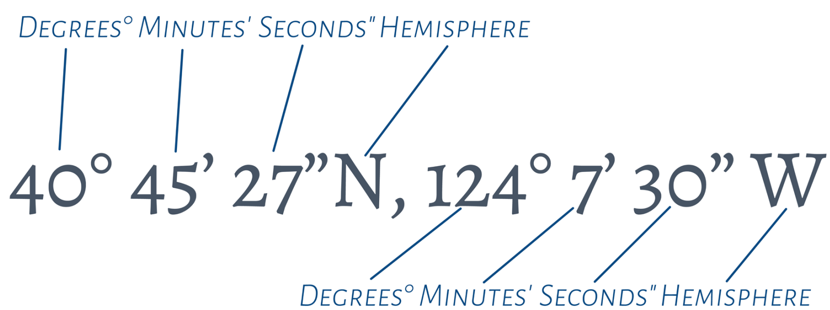


Figure 3–10: The correct notation starts with latitude, followed by longitude.

Determining Latitude and Longitude on an Aeronautical Sectional Chart

Longitude in the western hemisphere increases as you travel west and decreases as you move east. Likewise, longitude increases as you journey north and decreases as you move south. The lines for latitude and longitude on the sectional chart indicates every **thirty minutes** of either latitude or longitude.[**Figure 3–11**]

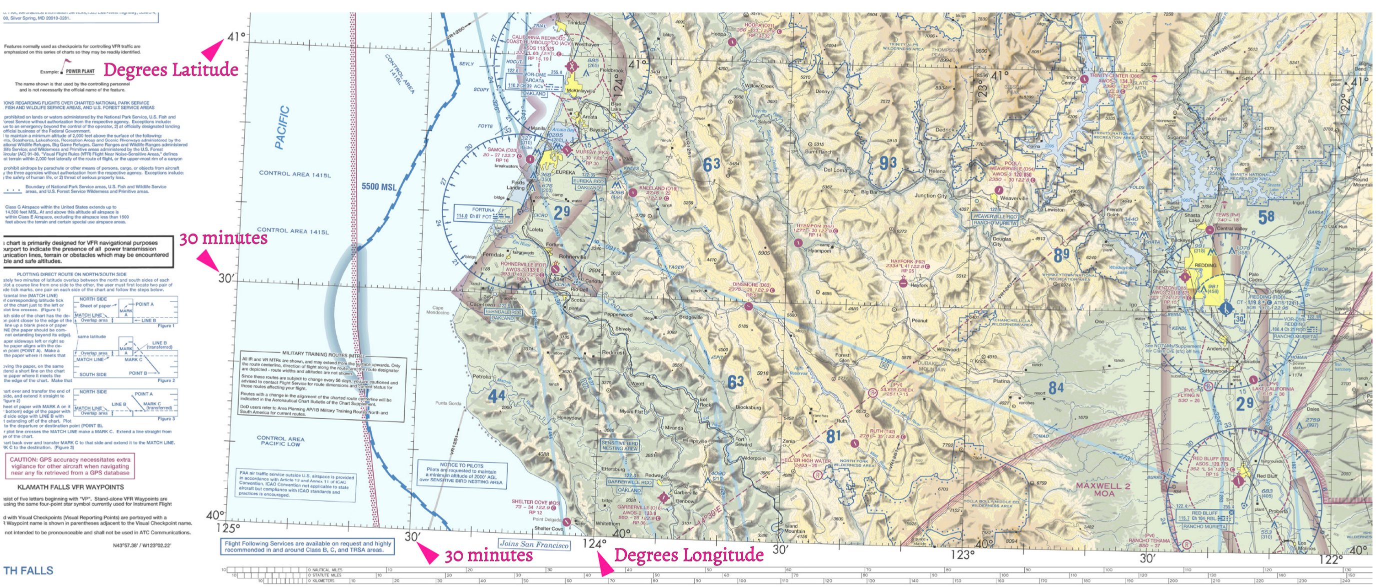


Figure 3–11: The pink arrows point to lines of latitude and longitude spaced 30 minutes apart.

Readers may be asked by the FAA to identify an airport based on geographic coordinates (latitude and longitude). To do so, one should locate the nearest lines of latitude and longitude in degrees. Then count the tick marks until the exact coordinates

are determined on the map. The small tick marks represent one minute and the larger tick marks represent ten minutes. [**Figure 3–12**]

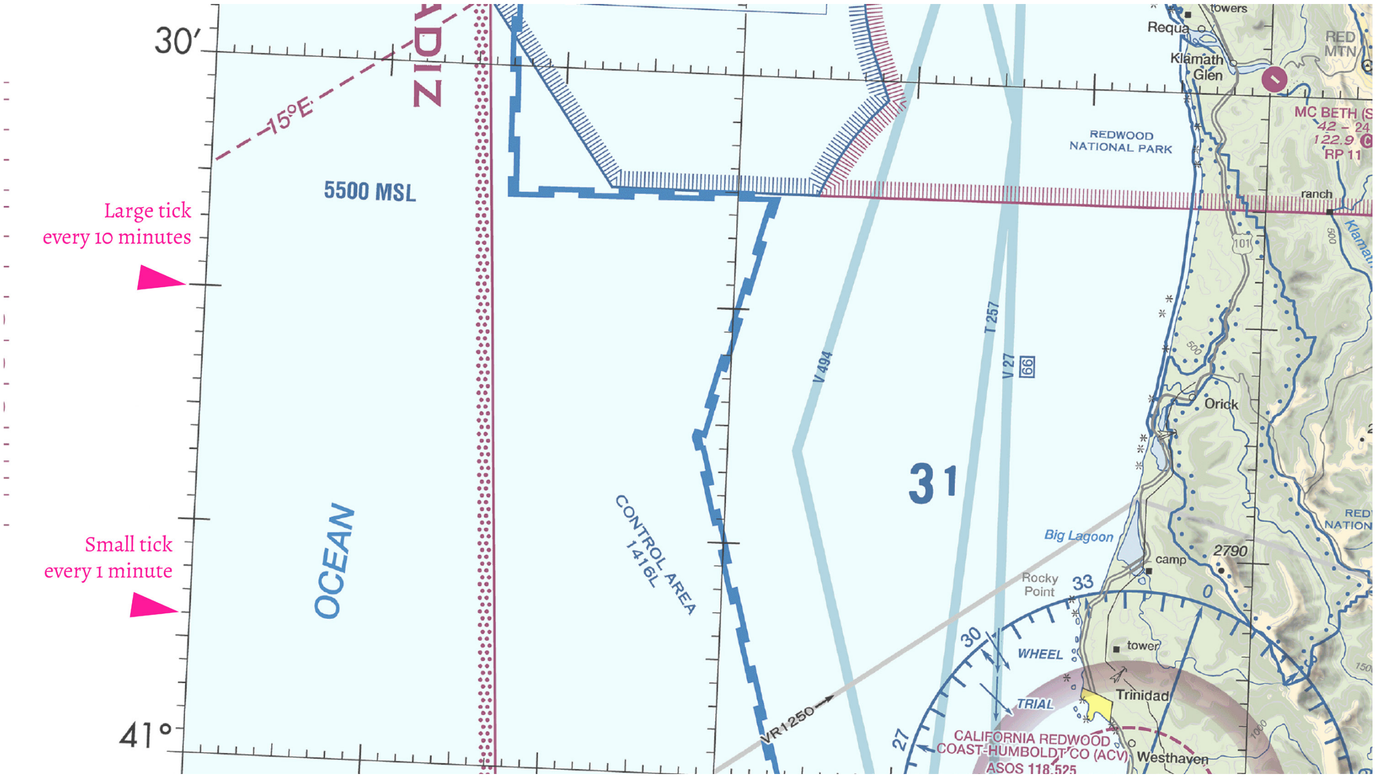


Figure 3–12: The larger ticks represent 10 minutes, and the smaller ticks represent 1 minute.

For Example, suppose the FAA asked you to identify the airport located at approximately 40°59' N 124°06'W. On the map, you would locate the line of latitude for 41°N and subtract one tick mark. This location would be 40°59'. You could then draw a line through that tickmark along the length of the map. Next, you would locate the line of longitude that represented 124°W and add six tick marks. You could also draw a line through that tickmark along the length of the map. [**Figure 3–13**] The answer to the question would be the nearest airport to the intersection of your lines. In this instance, the answer is California Redwood Coast-Humboldt CO (ACV).

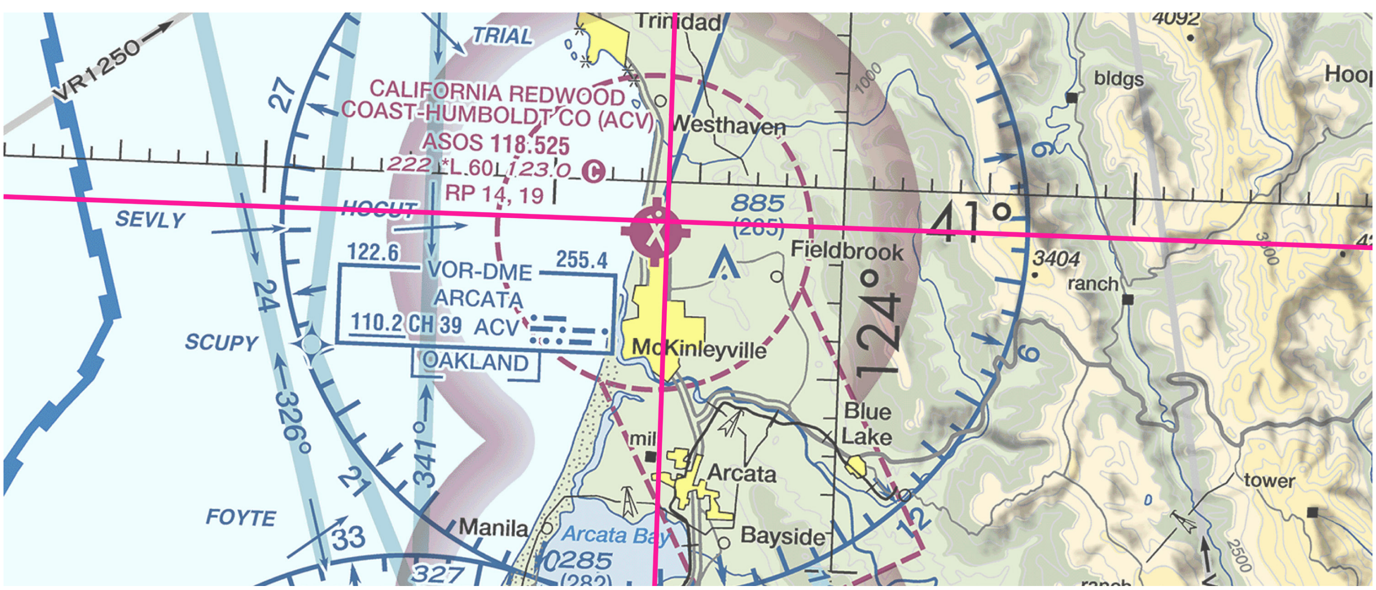


Figure 3–13: Drawing lines along the correct tick marks helps to narrow down the potential answers to the question.

Variation

Variation is the angle between **true north (TN)** and **magnetic north (MN)**. It is expressed as east variation or west variation depending upon whether MN is to the east or west of TN. The north magnetic pole is located close to 71° N latitude, 96° W longitude, and is about 1,300 miles from the geographic or true north pole.[**Figure 3–14**] If the Earth were uniformly magnetized, the compass needle would point toward the magnetic pole, in which case the variation between TN (as shown by the geographical meridians) and MN (as shown by the magnetic meridians) could be measured at any intersection of the meridians.

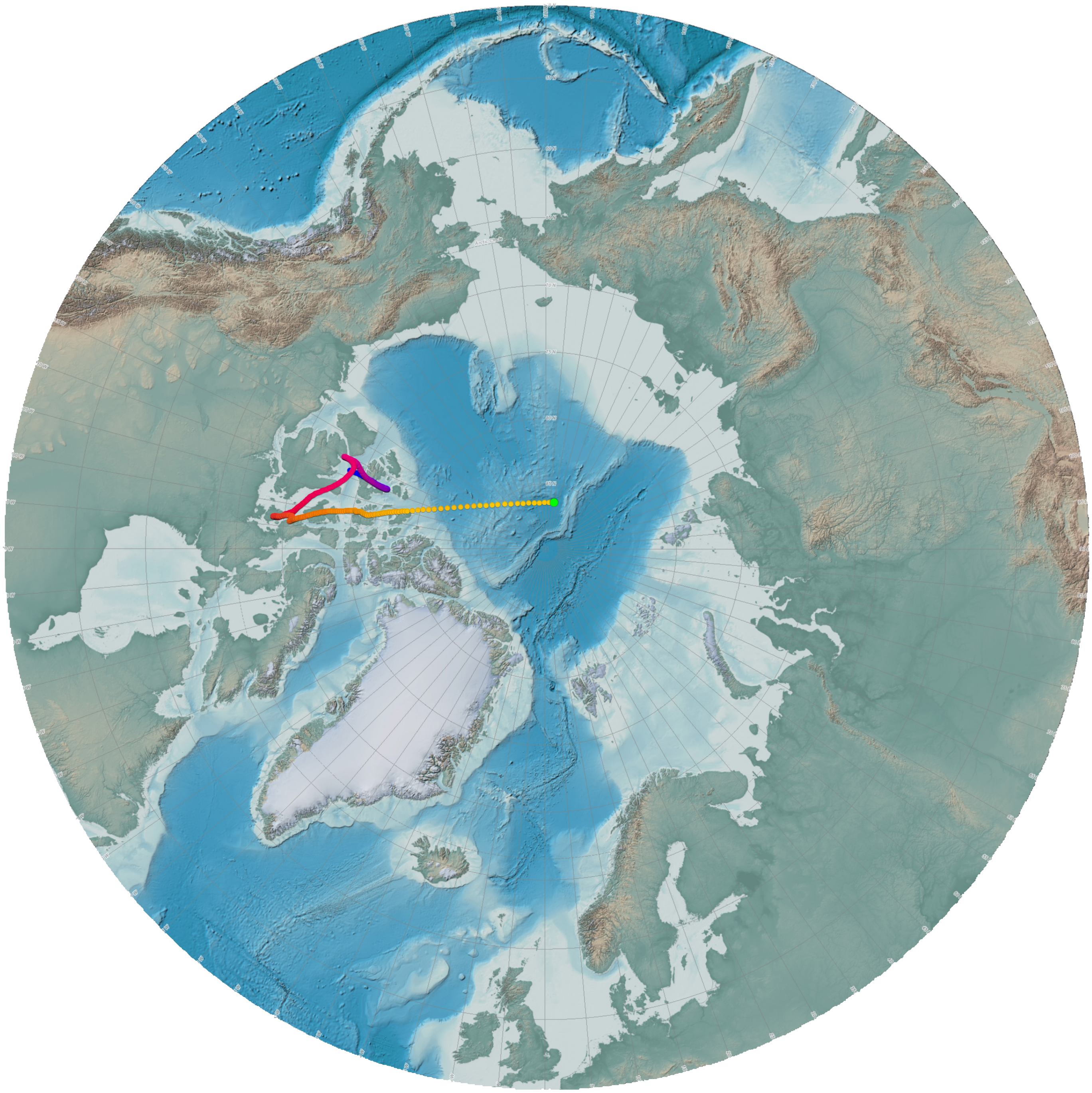


Figure 3–14: This map shows the historical track of the magnetic north pole 1590–2020 (predicted). The green dot indicates the current position of the north magnetic pole. Source: NOAA Declination Map Viewer.

Actually, the Earth is not uniformly magnetized. In the United States, the needle usually points in the general direction of the magnetic pole, but it may vary in certain geographical localities by many degrees. Consequently, the exact amount of variation at thousands of selected locations in the United States has been carefully determined. The amount and the direction of variation, which change slightly from time to time, are shown on most aeronautical charts as broken magenta lines called **isogonic lines** that connect points of equal magnetic variation. (The line connecting points at which there is no variation between TN and MN is the agonic line.) Minor bends and turns in the isogonic and agonic lines are caused by unusual geological conditions affecting magnetic forces in these areas.

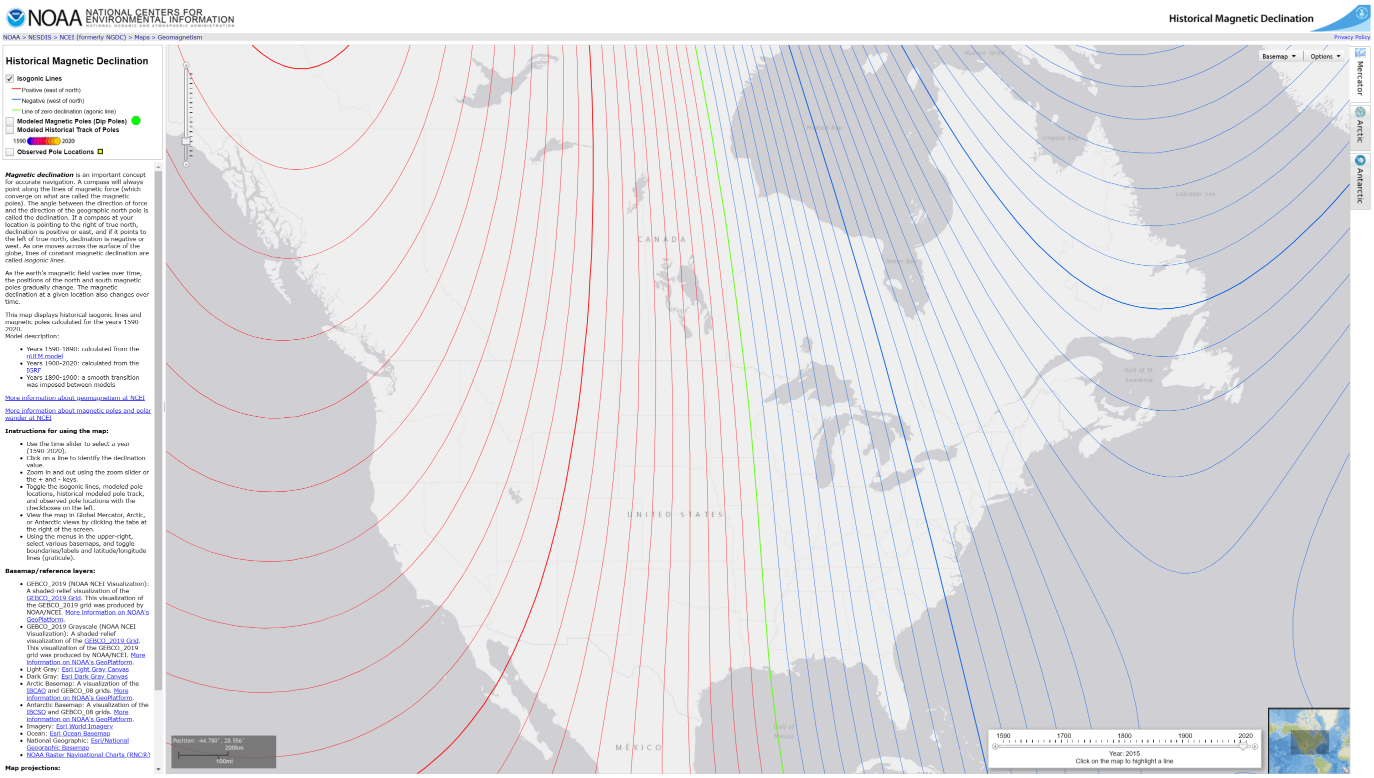


Figure 3–15: This map shows an isogonic map of the continental United States as of 2019. Red lines on the map indicate positive declination (east). Blue lines on the map indicate negative declination (west). The green line running through the Midwest is the agonic line, which has 0° declination. Source: NOAA Declination Map Viewer.

Antenna Towers and Obstructions

Extreme caution should be exercised when flying less than 2,000 feet AGL because of numerous skeletal structures, such as radio and television antenna towers, that exceed 1,000 feet AGL with some extending higher than 2,000 feet AGL. Most skeletal structures are supported by guy wires, which are very difficult to see in good weather and can be invisible at dusk or during periods of reduced visibility. These wires can extend about 1,500 feet horizontally from a structure; therefore, all skeletal structures should be avoided horizontally by at least 2,000 feet. Additionally, new towers may not be on your current chart because the information was not received prior to the printing of the chart.

Identifying Obstructions on an Aeronautical Sectional Chart

The FAA wants remote pilots to be able to identify towers and obstructions on a sectional chart. The most common symbol for obstructions looks like an upside-down V with a dot. For multiple obstructions, the sectional chart may show more than one of these symbols clustered together.[**Figure 3–16**] This symbol may represent a number of obstructions, including antenna towers and tall buildings. Above the symbol, readers will see a set of numbers. The number on the top, shown in bold font, represents the **elevation** in feet of the top of the obstruction above sea mean level (MSL). Below the MSL, another number enclosed in parenthesis represents the **height** in feet of the top of the obstruction above ground level (AGL). For the Aeronautical Knowlege Exam, it is important to be able to distinguish between the two numbers.

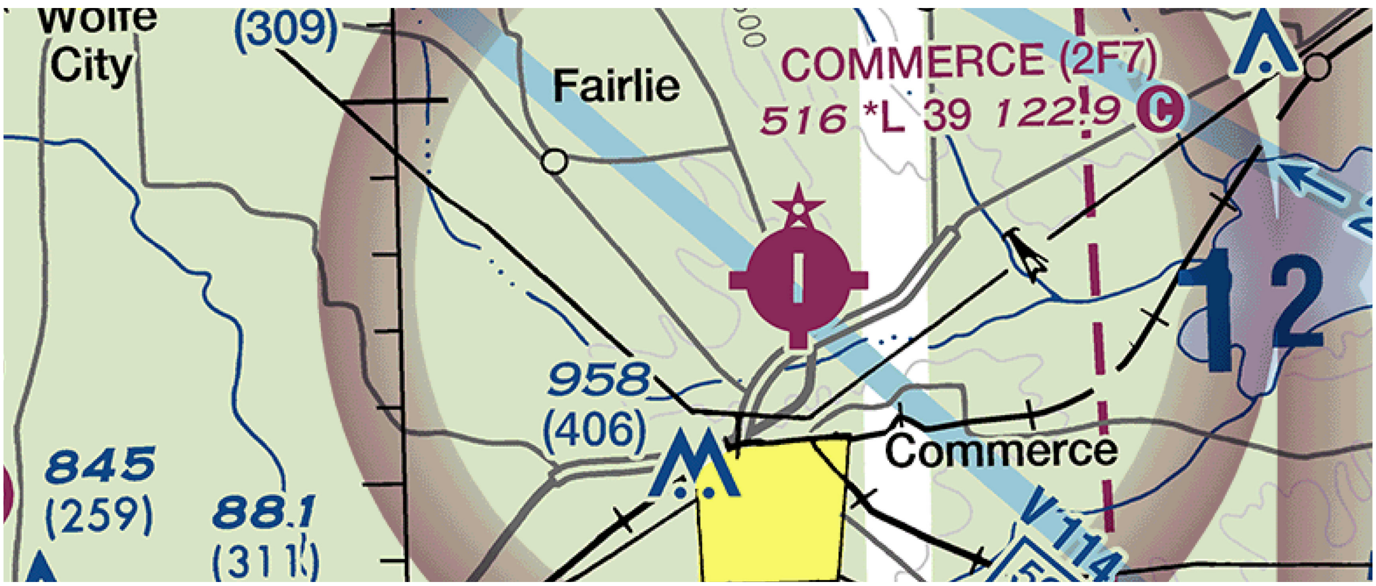


Figure 3–16: The top of the obstruction southwest of Commerce (2F7) has an elevation of 950 feet MSL and a height of 406 feet AGL.

Sometimes a sectional chart will show a symbol that looks similar to the Eiffel Tower. [**Figure 3–17**] This symbol indicates that the top of the obstruction is at least 1,000 feet AGL. If there is a starburst on top of the symbol, this indicates that there are high-intensity lights.

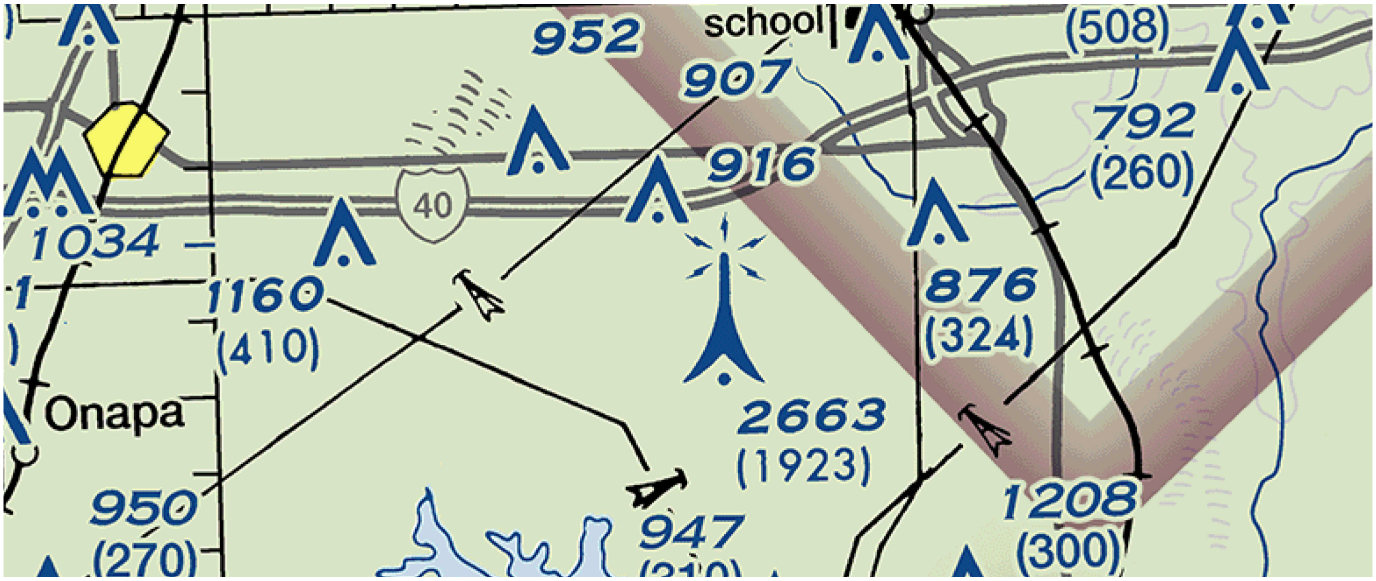


Figure 3–17: The top of the obstruction indicated by the Eiffel Tower type symbol has an elevation of 2,663 feet MSL and a height of 1,923 feet AGL. Because there is a starburst on top of the symbol, there are also high-intensity lights on the obstruction.

Another obstruction you may encounter involves a balloon or blimp with a cable that extends to the ground. While the balloon is large enough to see, the cable represents a potential hazard to aircraft. On a sectional chart, this type of obstruction is indicated using a box of text called an aerostat. [**Figure 3–18**] Sometimes, the aerostat will also indicate the height of the obstruction.

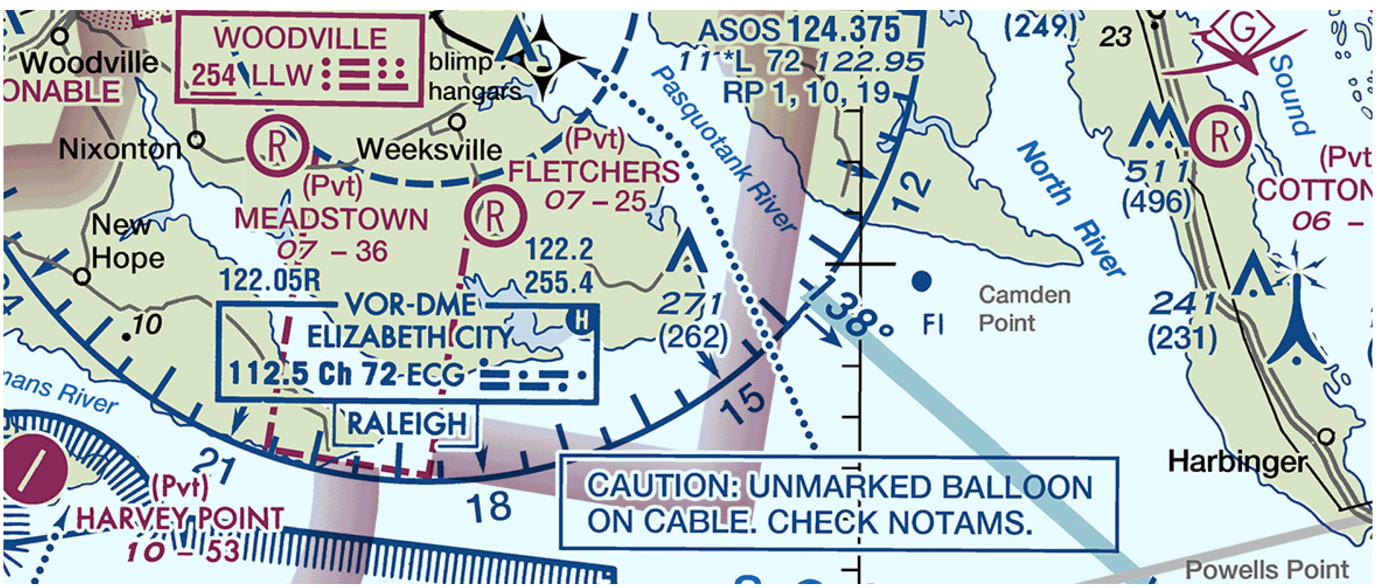


Figure 3–18: The aerostat near the bottom of this figure indicates an unmarked balloon on a cable.

Determining Elevation on an Aeronautical Sectional Chart

The FAA wants remote pilots to be able to estimate elevation above mean sea level (MSL) on unmarked portions of an aeronautical sectional chart. The elevation is color-coded every 1,000 feet and the contour intervals are every 500 feet. [**Figure 3–19**]

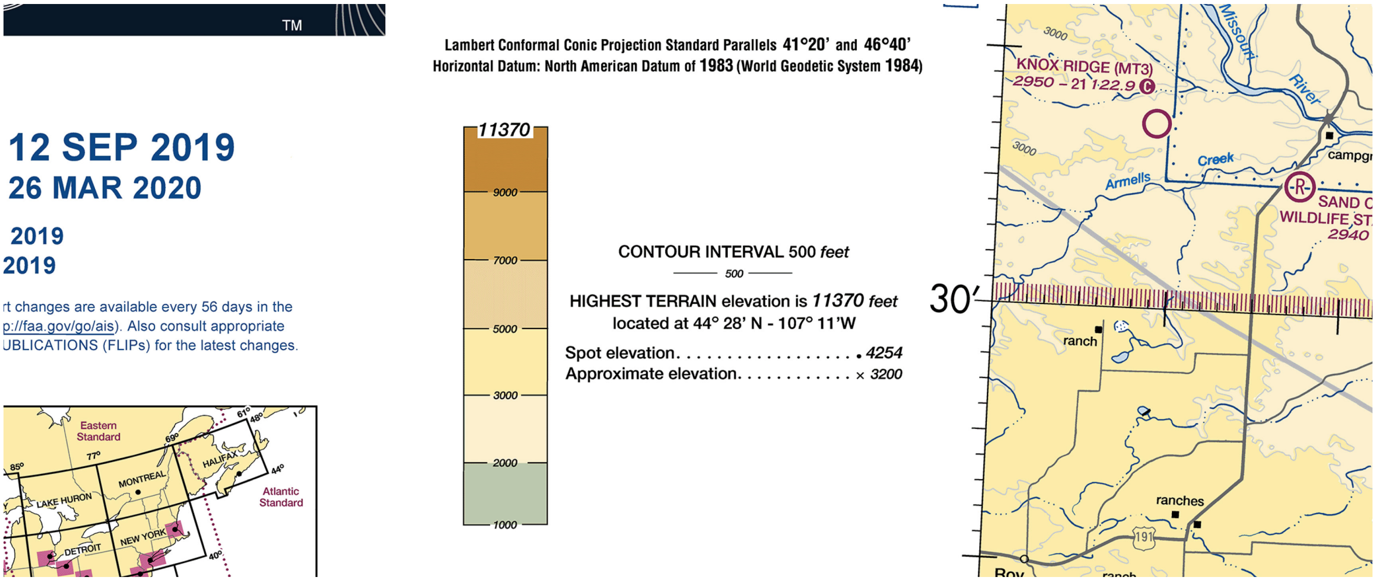


Figure 3–19: The legend on a sectional chart indicates the contour interval and the color code.

For example, suppose the FAA asks you to find the approximate elevation of the tan area just north of Audubon Lake. [**Figure 3–20**] The legend indicates that the tan areas on the map indicate elevations between 2,000 feet and 3,000 feet. A closer look reveals the contour line at the boundary between the green and tan areas is at 2,000 feet. Since there are no additional contour lines in the area, and each contour line represents an interval of 500 feet, it would be safe to assume that the tan area just north of Audubon Lake is between 2,000 feet and 2,500 feet.

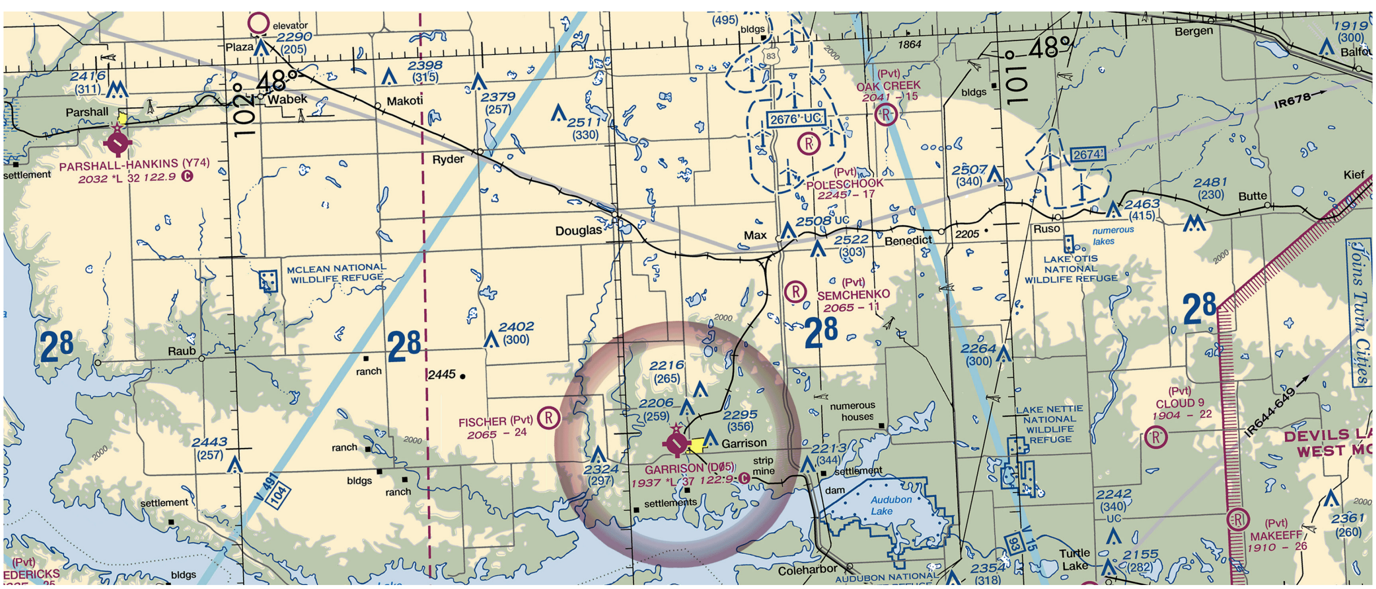


Figure 3–20: The tan area just north of Audubon Lake is between 2,000 feet and 2,500 feet.

Airspace Classification

The two categories of airspace are: regulatory and nonregulatory. Within these two categories, there are four types: controlled, uncontrolled, special use, and other airspace. The categories and types of airspace are dictated by the complexity or density of aircraft movements, nature of the operations conducted within the airspace, the level of safety required, and national and public interest. **Figure 3–21** presents a profile view of the dimensions of various classes of airspace.

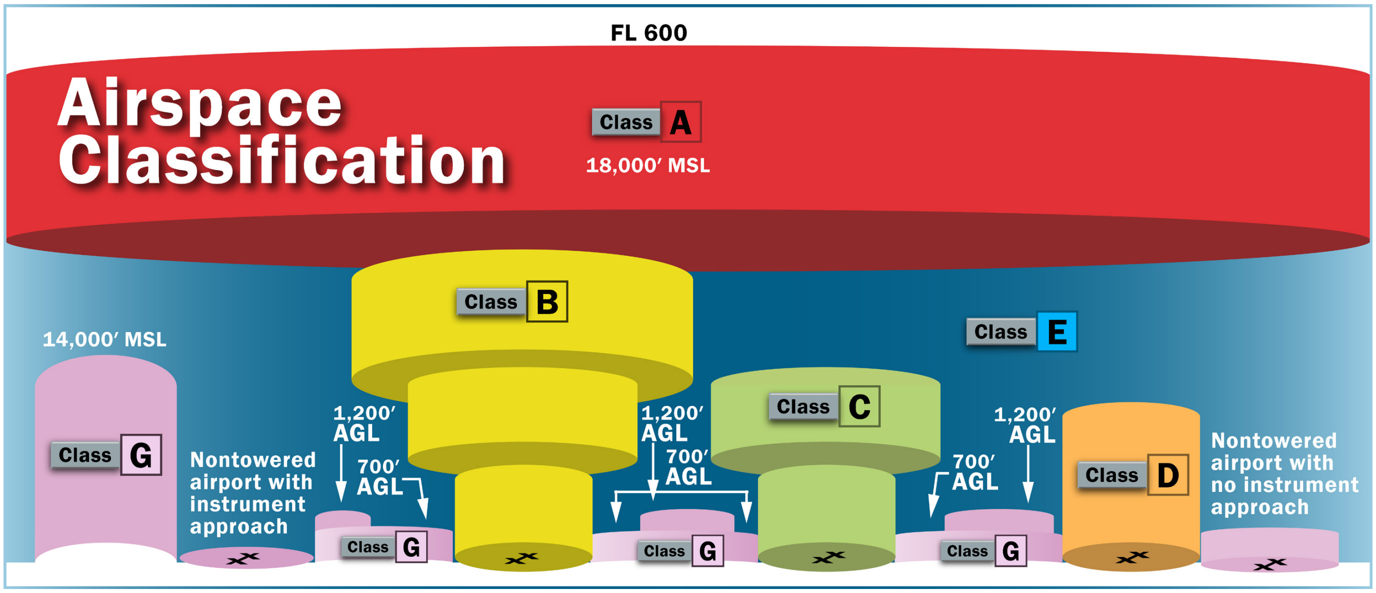


Figure 3–21: The airspace system designations standardize airspace classifications with other countries.

Controlled Airspace

Controlled airspace is a generic term that covers the different classifications of airspace and the defined dimensions within which air traffic control (ATC) service is provided in accordance with the airspace classification. On sectional charts, airports with control towers are shown using a blue symbol. Airports with no control tower are shown using a magenta symbol. The controlled airspace that is of concern to the remote pilot is listed below:

- Class B
- Class C
- Class D
- Class E

Class B Airspace

Class B airspace is generally airspace from the surface to 10,000 feet mean sea level (MSL) surrounding the nation's busiest airports in terms of airport operations or passenger enplanements. The configuration of each Class B airspace area is individually tailored, consists of a surface area and two or more layers (some Class B airspace areas resemble upside-down wedding cakes) [**Figure 3–22**] and is designed to contain all published instrument procedures once an aircraft enters the airspace. A remote pilot must receive authorization from ATC before operating in the Class B airspace. [**Figure 3–23**]

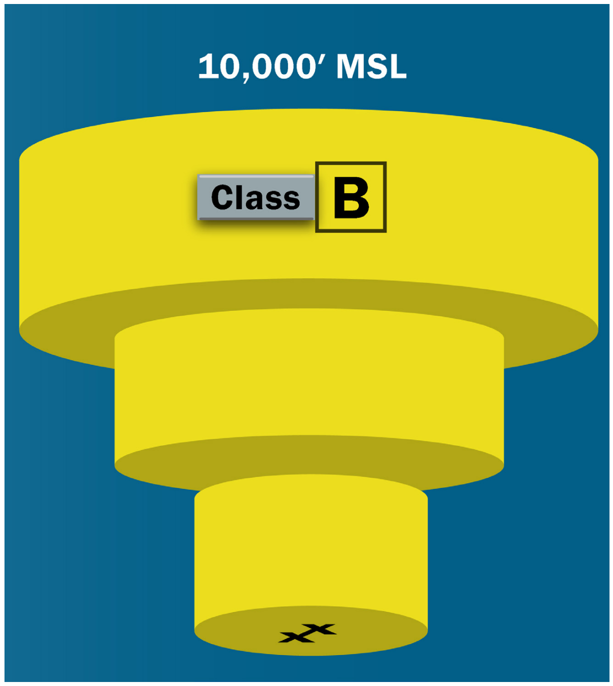


Figure 3–22: The largest and most busy airports are located in Class B airspace.

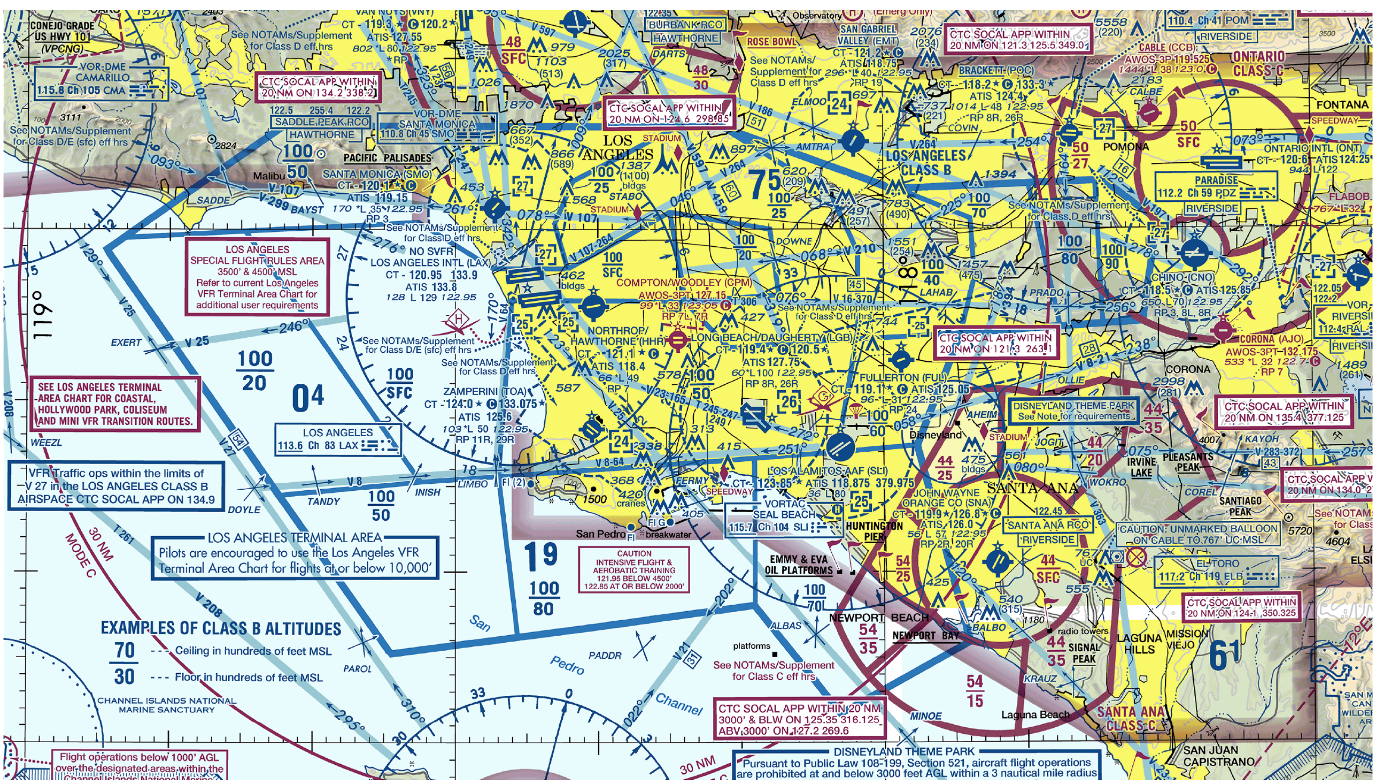


Figure 3–23: On sectional charts, the dark solid blue lines indicate Class B airspace.

Class C Airspace

Class C airspace is generally airspace from the surface to 4,000 feet above the airport elevation (charted in MSL) surrounding those airports that have an operational control tower, are serviced by a radar approach control, and have a certain number of instrument flight rules (IFR) operations or passenger enplanements. Although the configuration of each Class C area is individually tailored, the airspace usually consists of a surface area with a five nautical mile (NM) radius, an outer circle with a ten NM radius that extends from 1,200 feet to 4,000 feet **above the airport elevation**. [**Figure 3–24**] A remote pilot must receive authorization before operating in Class C airspace. [**Figure 3–25**]

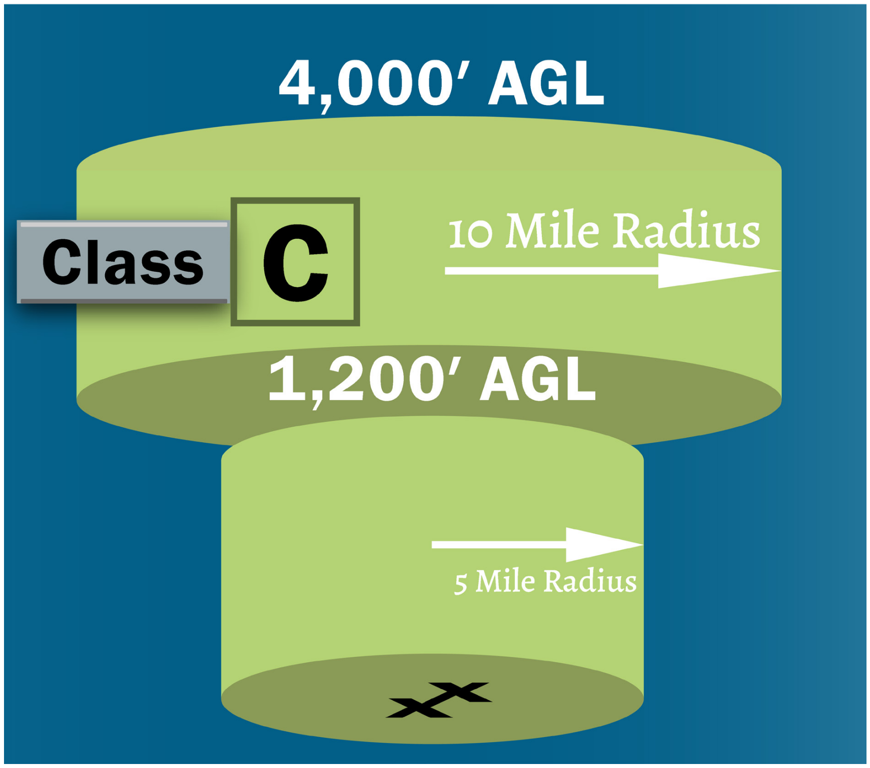


Figure 3–24: Class C airspace.

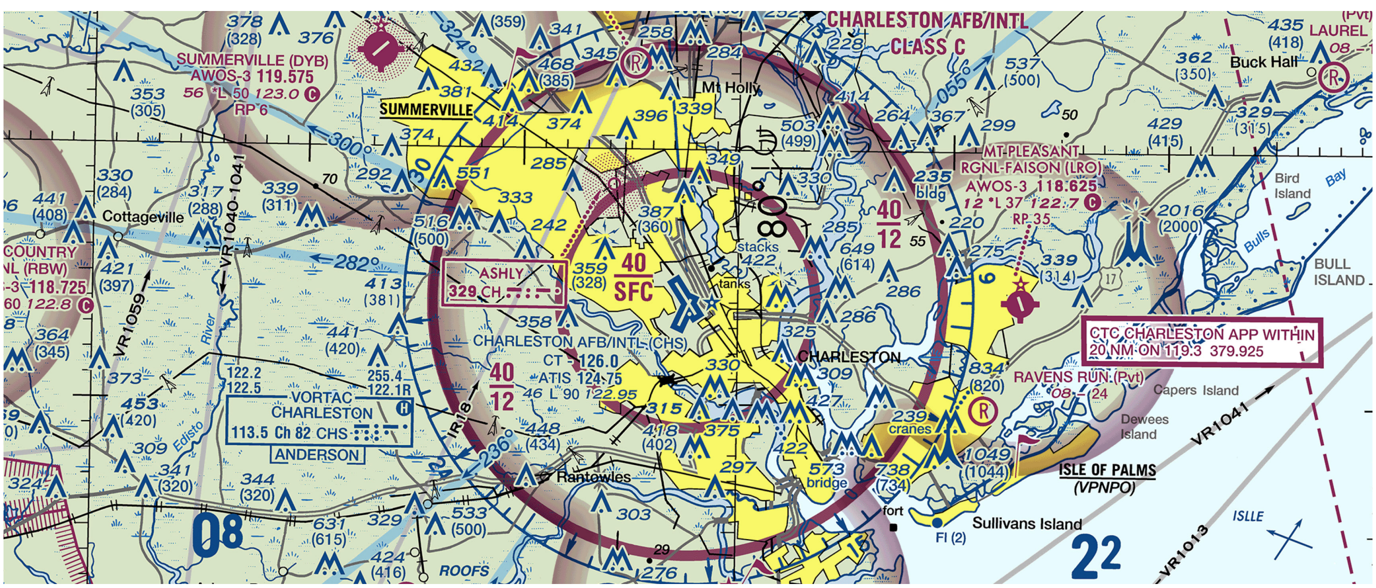


Figure 3–25: On sectional charts, the dark solid magenta lines indicate Class C airspace.

Class C airspace also has a **Procedural Outer Area** of **20 nautical miles**. from the airport

Class D Airspace

Class D airspace is generally airspace from the surface to 2,500 feet above the airport elevation (charted in MSL) surrounding those airports that have an operational control tower. [**Figure 3–26**] The configuration of each Class D airspace area is individually tailored, and, when instrument procedures are published, the airspace is normally designed to contain the procedures. Arrival extensions for instrument approach procedures (IAPs) may be Class D or Class E airspace. A remote pilot must receive ATC authorization before operating in Class D airspace [**Figure 3–27**].

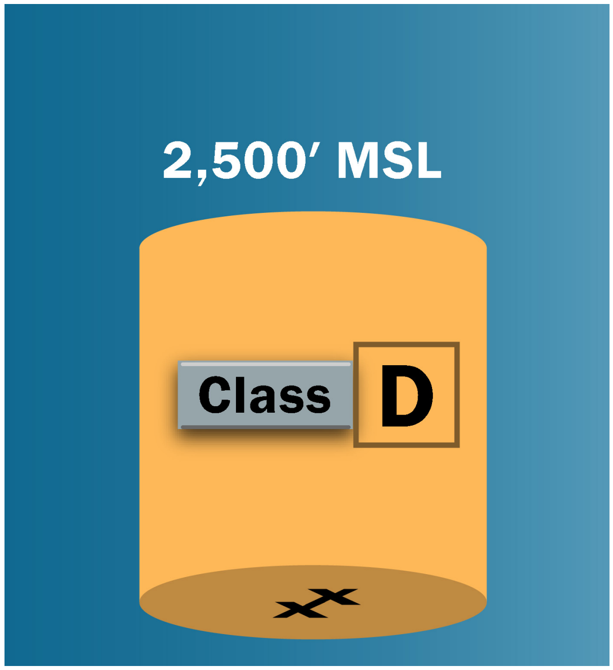


Figure 3–26: Class D airspace.

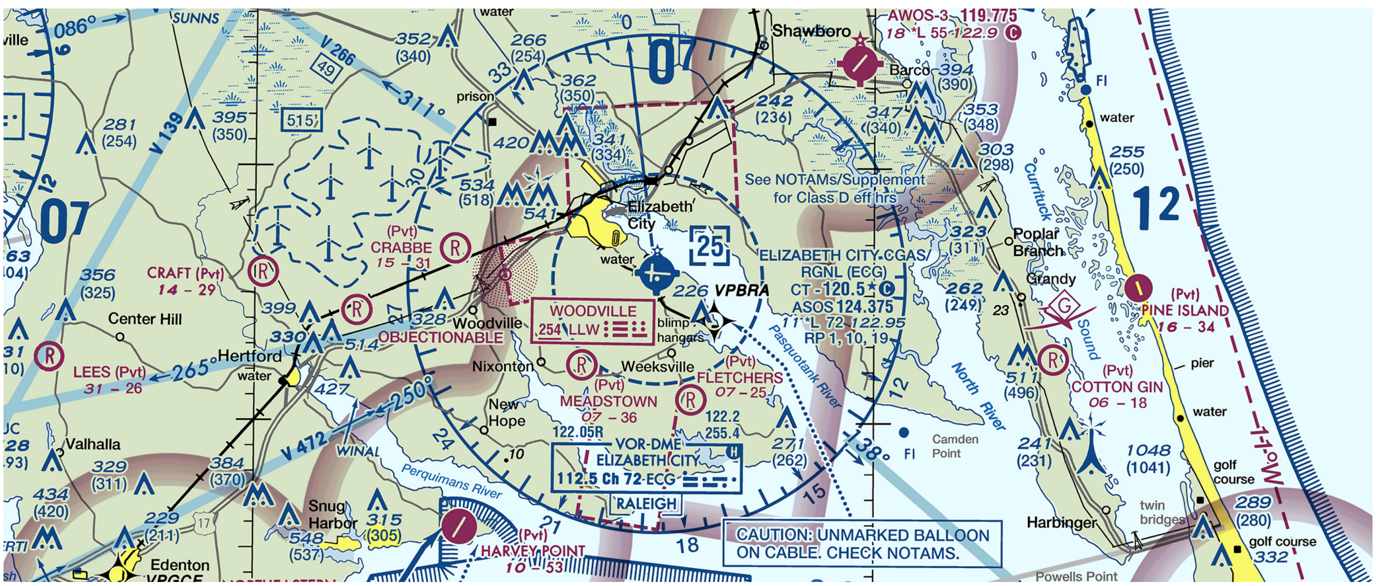


Figure 3–27: On sectional charts, the dashed blue lines indicate Class D airspace.

Class E Airspace

Class E airspace is the controlled airspace not classified as Class A, B, C, or D airspace. A large amount of the airspace over the United States is designated as Class E airspace. This provides sufficient airspace for the safe control and separation of aircraft during IFR operations. Chapter 3 of the ***Aeronautical Information Manual (AIM)***[1] explains the various types of Class E airspace.

Sectional and other charts depict all locations of Class E airspace with bases below 14,500 feet MSL. [**Figure 3–28**] In areas where charts do not depict a class E base, class E begins at 14,500 feet MSL. In most areas, the Class E airspace base is 1,200 feet above ground level (AGL). In many other areas, the Class E airspace base is either the surface or 700 feet AGL. Some Class E airspace begins at an MSL altitude depicted on the charts, instead of an AGL altitude. Class E airspace typically extends up to, **but not including**, 18,000 feet MSL (the lower limit of Class A airspace) [**Figure 3–29**]. All airspace above FL 600 is Class E airspace.

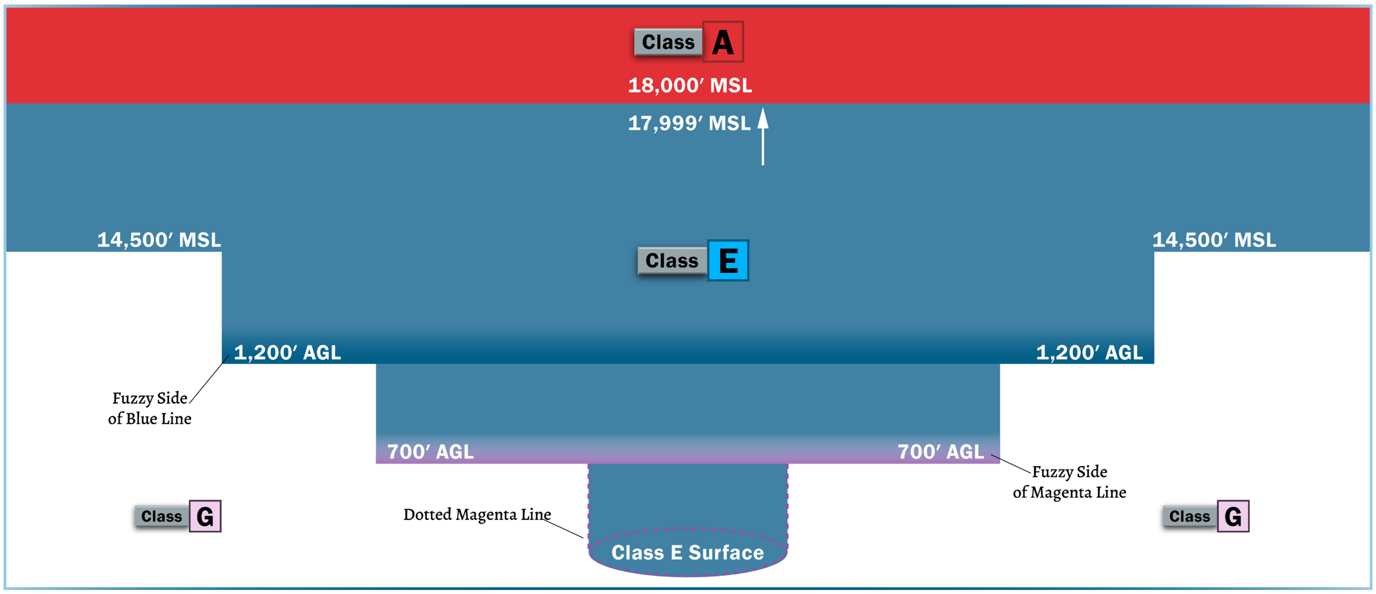


Figure 3–28: Class E airspace.

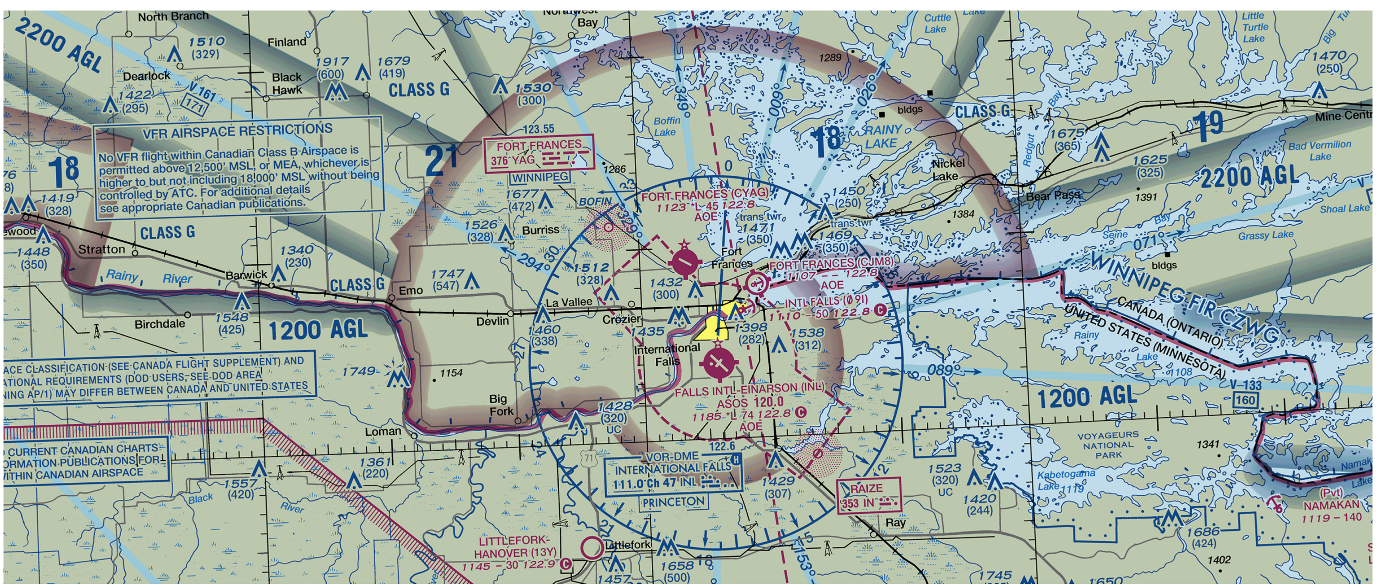


Figure 3–29: On sectional charts, the dotted magenta lines indicate that Class E airspace extends to the surface. The fuzzy side of a thick magenta line indicates the floor of Class E begins at 700 feet AGL. The fuzzy side of a thick blue line indicates the floor of Class E begins at 1,200 feet AGL.

1 URL: https://www.faa.gov/air_traffic/publications/media/aim.pdf

Federal Airways, which are shown as blue lines on a sectional chart, are usually found within Class E airspace. Federal Airways start at 1,200' AGL and go up to, but not including 18,000' MSL. [**Figure 3–30**] The width of a federal airway from either side of the centerline is four nautical miles.

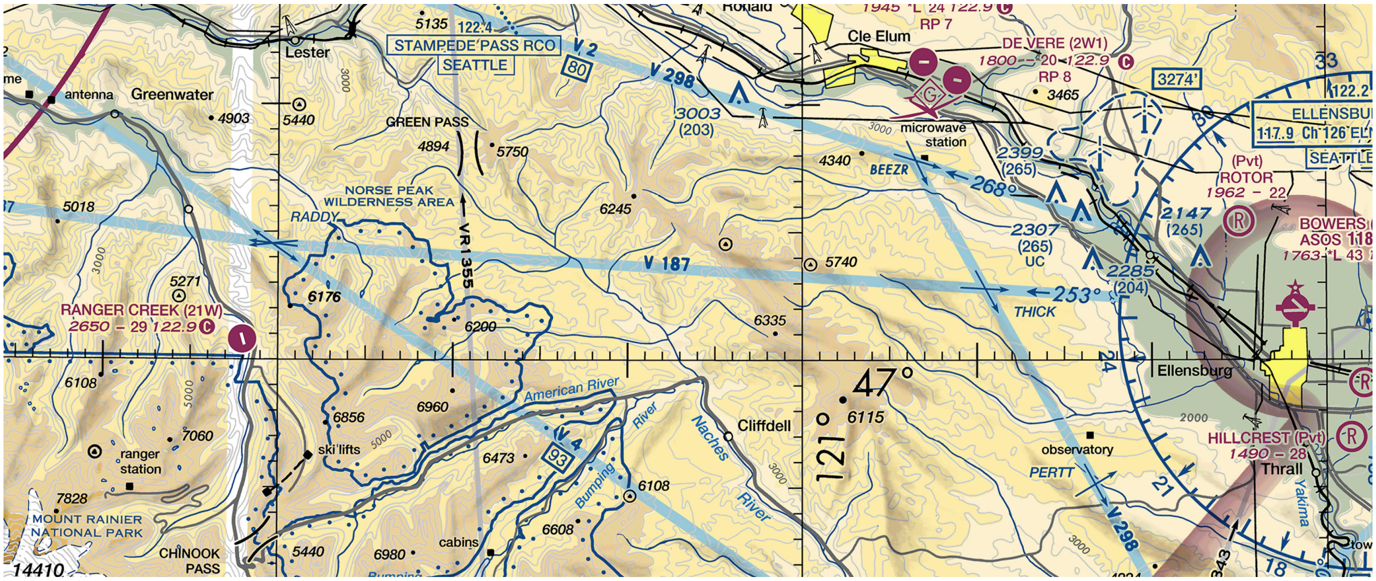


Figure 3–30: On sectional charts, the light blue lines indicate Federal Airways.

In most cases, a remote pilot will not need ATC authorization to operate in Class E airspace.

Uncontrolled Airspace

Class G Airspace

Uncontrolled airspace or Class G airspace is the portion of the airspace that has not been designated as Class A, B, C, D, or E. It is therefore designated uncontrolled airspace. Class G airspace extends from the surface to the base of the overlying Class E airspace . [**Figure 3–28**] A remote pilot will not need ATC

e

Special Use Airspace

Special use airspace or special area of operation (SAO) is the designation for airspace in which certain activities must be confined, or where limitations may be imposed on aircraft operations that are not part of those activities. Certain special use airspace areas can create limitations on the mixed-use of airspace. The special use airspace depicted on instrument charts includes the area name or number, effective altitude, time and weather conditions of operation, the controlling agency, and the chart panel location. On National Aeronautical Charting Group (NACG) en route charts, this information is available on one of the end panels. Special use airspace usually consists of:

- Prohibited areas
- Restricted areas
- Warning areas
- Military operation areas (MOAs)
- Alert areas
- Controlled firing areas (CFAs

Prohibited Areas

Prohibited areas contain airspace of defined dimensions within which the flight of aircraft is prohibited. Such areas are established for security or other reasons associated with the national welfare. These areas are published in the Federal Register and are depicted on aeronautical charts. The area is charted as a "P" followed by a number (e.g., P-40). Examples of prohibited areas include Camp David and the National Mall in Washington, D.C., where the White House and the Congressional buildings are located.[**Figure 3–31**]

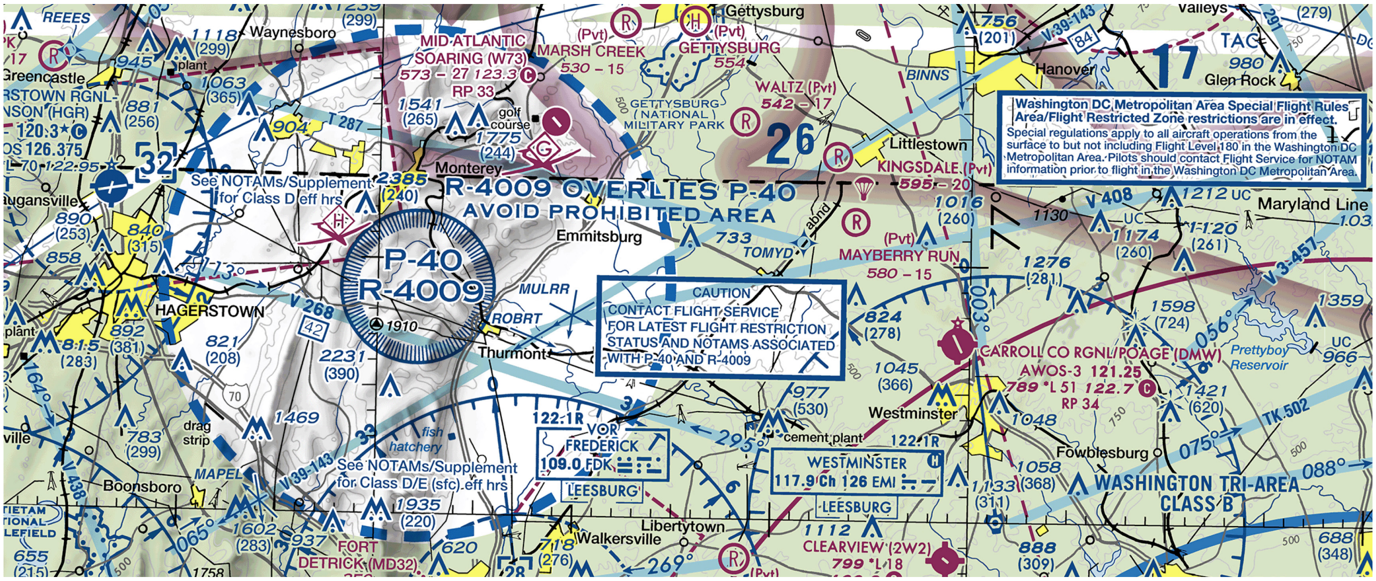


Figure 3–31: An example of a prohibited area, P-40 around Camp David.

Pilots flying VFR within 60 nautical miles of Washington National Airport must complete a special awareness training and must have proof of completion with them at all times. Pilots must also remain clear of the special flight rules area (SFRA) that extends 30 nautical miles from the airport. [**Figure 3–32**]

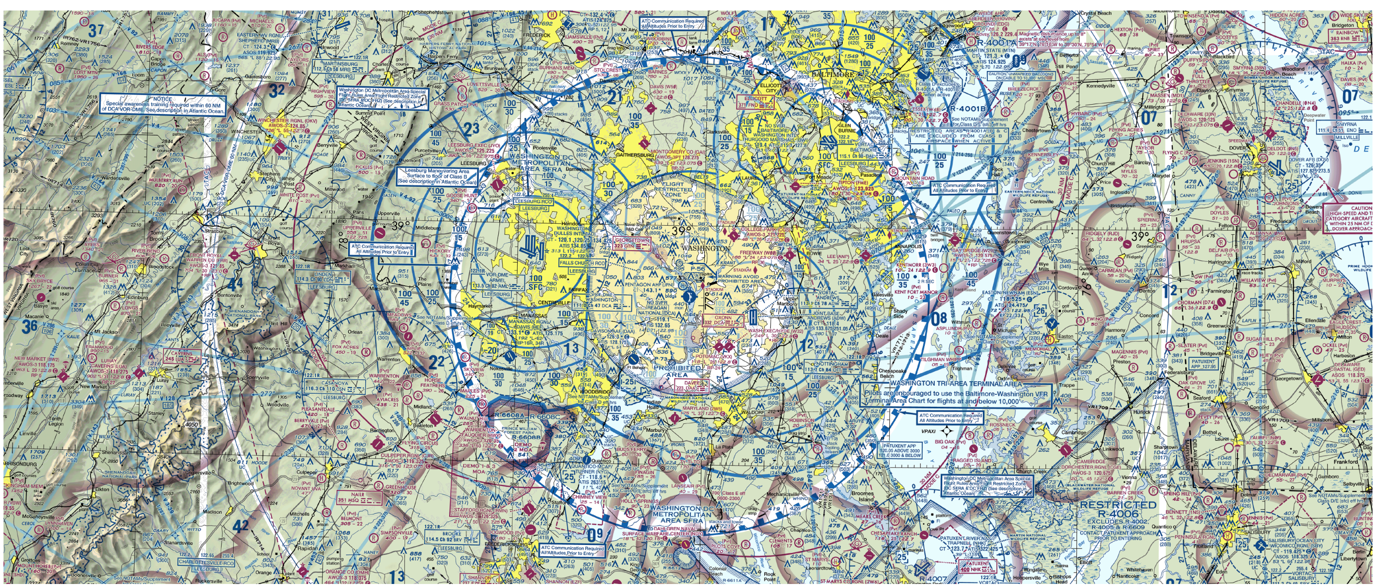


Figure 3–32: On sectional charts, the crenelated blue circle represents the SFRA and extends 30 nautical miles from the Washington National Airport. The white circle beyond extends to 60 nautical miles.

Restricted Areas

Restricted areas are areas where operations are hazardous to nonparticipating aircraft and contain airspace within which the flight of aircraft, while not wholly prohibited, is subject to restrictions. Activities within these areas must be confined because of their nature, or limitations may be imposed upon aircraft operations that are not a part of those activities, or both. Restricted areas denote the existence of unusual, often invisible, hazards to aircraft (e.g., artillery firing, aerial gunnery, or guided missiles). The penetration of restricted areas without authorization from the using or controlling agency may be extremely hazardous to the aircraft. [**Figure 3–33**]

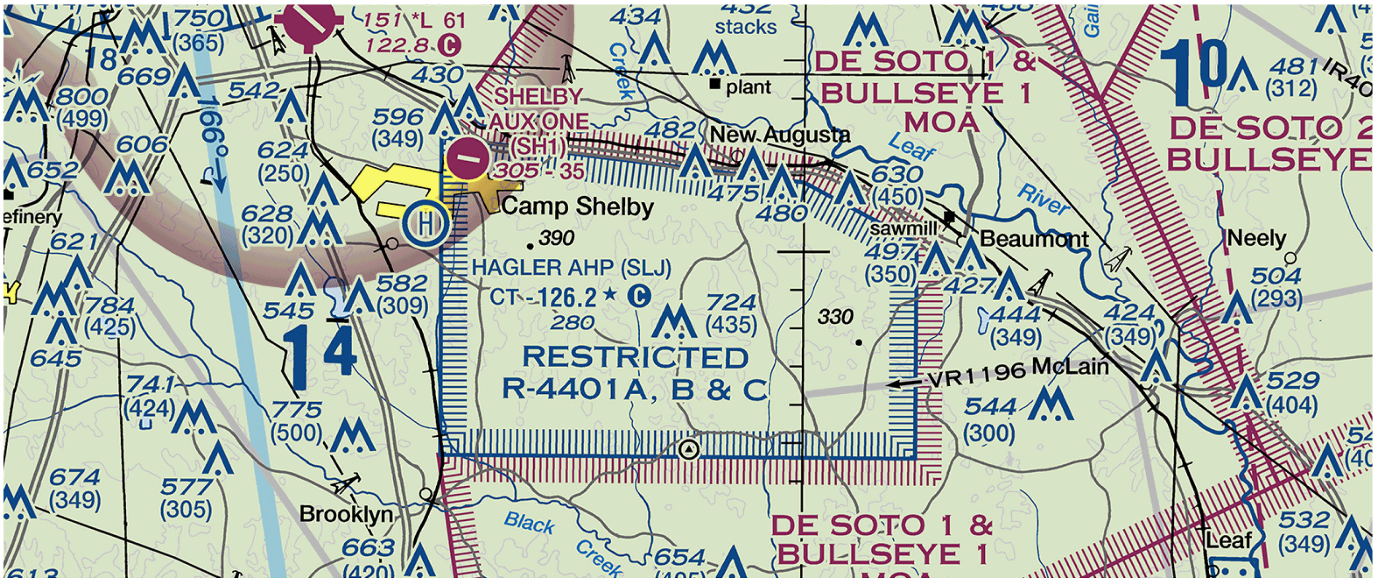


Figure 3–33: Restricted areas on a sectional chart

1. If the restricted area is not active and has been released to the FAA, the ATC facility allows the aircraft to operate in the restricted airspace without issuing specific clearance for it to do so.
2. If the restricted area is active and has not been released to the FAA, the ATC facility issues a clearance that ensures the aircraft avoids the restricted airspace.

Restricted areas are charted with an "R" followed by a number (e.g., R-4401) and are depicted on the en-route chart appropriate for use at the altitude or flight level (FL) being flown. Restricted area information can be obtained on the back of the chart.

Warning Areas

Warning areas are similar in nature to restricted areas; however, the United States government does not have sole jurisdiction over the airspace. A warning area is airspace of defined dimensions, extending from 3 NM outward from the coast of the United States, containing an activity that may be hazardous to nonparticipating aircraft. The purpose of such areas is to warn nonparticipating pilots of the potential danger. A warning area may be located over domestic or international waters or both. The airspace is designated with a "W" followed by a number (e.g., W-237). [**Figure 3–34**]

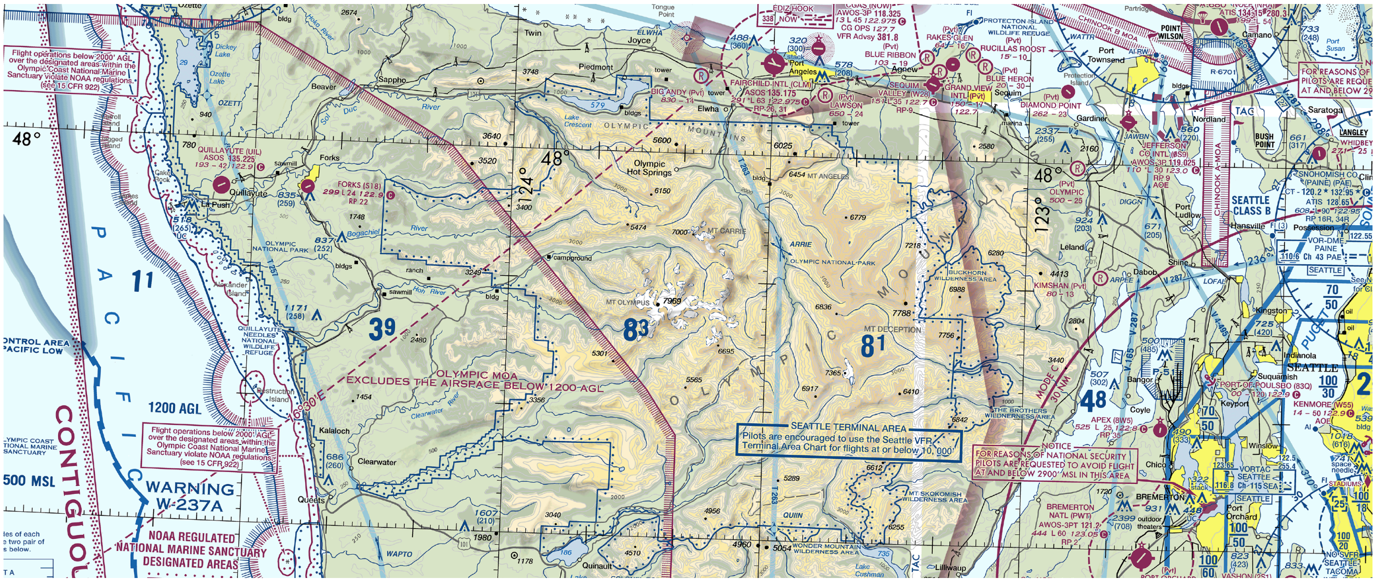


Figure 3–34: Requirements for airspace operations.

Military Operation Areas (MOAs)

MOAs consist of airspace with defined vertical and lateral limits established for the purpose of separating certain military training activities from IFR traffic. Whenever an MOA is being used, nonparticipating IFR traffic may be cleared through an MOA if IFR separation can be provided by ATC. Otherwise, ATC reroutes or restricts nonparticipating IFR traffic. MOAs are depicted on sectional, VFR terminal area, and en route low altitude charts and are not numbered (e.g., "Camden Ridge MOA"). [**Figure 3–35**] However, the MOA is also further defined on the back of the sectional charts with times of operation, altitudes affected, and the controlling agency.

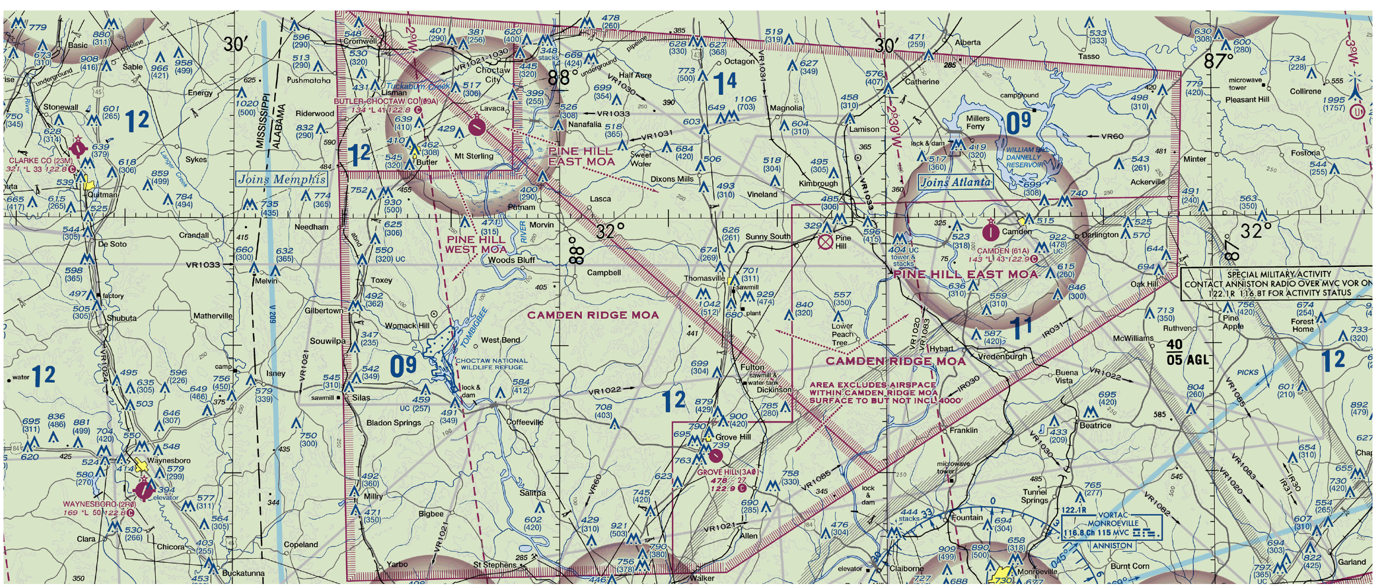


Figure 3–35: Camden Ridge MOA is an example of a military operations area.

Alert Areas

Alert areas are depicted on aeronautical charts with an "A" followed by a number (e.g., A-211) to inform nonparticipating pilots of areas that may contain a high volume of pilot training or an unusual type of aerial activity. Pilots should exercise caution in alert areas. All activity within an alert area shall be conducted in accordance with regulations, without a waiver, and pilots of participating aircraft, as well as pilots transiting the area, shall be equally responsible for collision avoidance. [**Figure 3–36**]

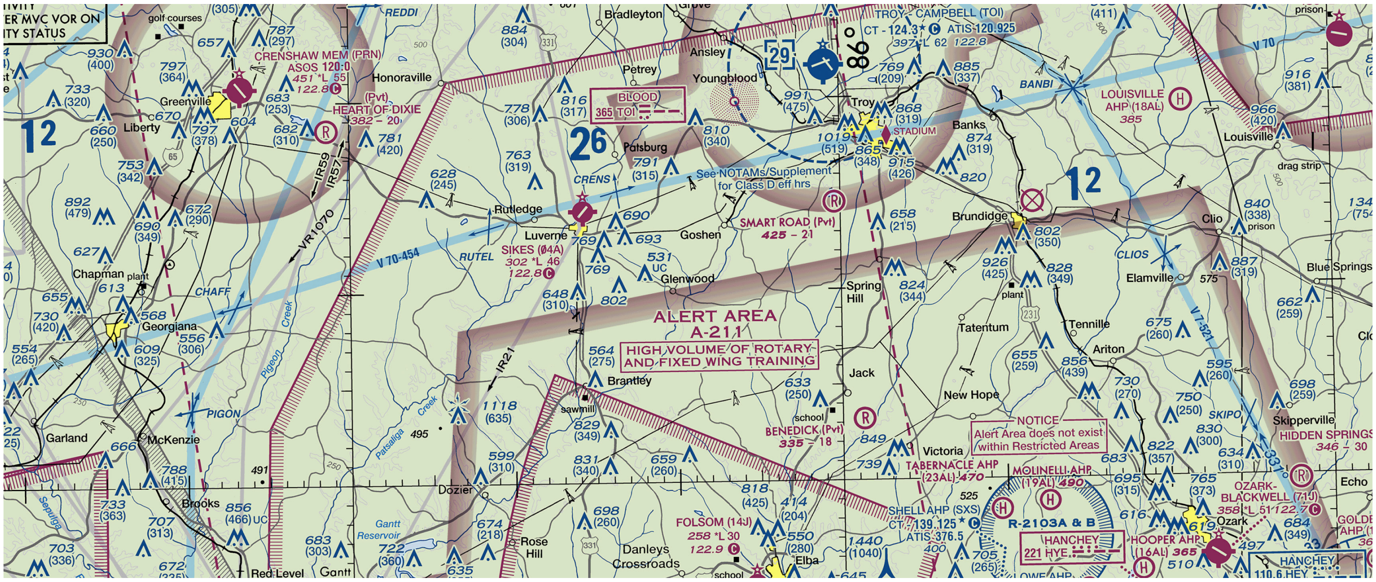


Figure 3–36: Alter area (A-211).

Controlled Firing Areas (CFAs)

CFAs contain activities that, if not conducted in a controlled environment, could be hazardous to nonparticipating aircraft. The difference between CFAs and other special use airspace is that activities must be suspended when a spotter aircraft, radar, or ground lookout position indicates an aircraft might be approaching the area. There is no need to chart CFAs since they do not cause a nonparticipating aircraft to change its flight path.

Other Airspace Areas

- "Other airspace areas" is a general term referring to the majority of the remaining airspace. It includes:
- Local airport advisory (LAA)
- Military training route (MTR)
- Temporary flight restriction (TFR)
- Parachute jump aircraft operations
- Published VFR routes
- Terminal radar service area (TRSA)
- National security area (NSA)
- Air Defense Identification Zones (ADIZ) land and water-based and need for Defense VFR (DVFR) flight plan to operate VFR in this airspace
- Flight Restricted Zones (FRZ) in the vicinity of Capitol and White House
- Wildlife Areas/Wilderness Areas/National Parks and request to operate above 2,000 AGL
- National Oceanic and Atmospheric Administration (NOAA) Marine Areas off the coast with the requirement to operate above 2,000 AGL
- Tethered Balloons for observation and weather recordings that extend on cables up to 60,000

Local Airport Advisory (LAA)

An advisory service provided by Flight Service facilities, which are located on the landing airport, using a discrete ground-to-air frequency or the tower frequency when the tower is closed. LAA services include local airport advisories, automated weather reporting with voice broadcasting, and a continuous Automated Surface Observing System (ASOS)/Automated Weather Observing Station (AWOS) data display, other continuous, direct reading instruments, or manual observations available to the specialist.

Military Training Routes (MTRs)

MTRs are routes used by military aircraft to maintain proficiency in tactical flying. These routes are usually established below 10,000 feet MSL for operations at speeds in excess of 250 knots. Some route segments may be defined at higher altitudes for purposes of route continuity. Routes are identified as IFR (IR) and VFR (VR), followed by a number. [**Figure 3–37**] MTRs with no segment above 1,500 feet AGL are identified by four number characters (e.g., IR1206, VR1207). MTRs that include one or more segments above 1,500 feet AGL are identified by three number characters (e.g., IR206, VR207). IFR low altitude en route charts depicts all IR routes and all VR routes that accommodate operations above 1,500 feet AGL. IR routes are conducted in accordance with IFR regardless of weather conditions. VFR sectional charts depict military training activities, such as IR, VR, MOA, restricted area, warning area, and alert area information.

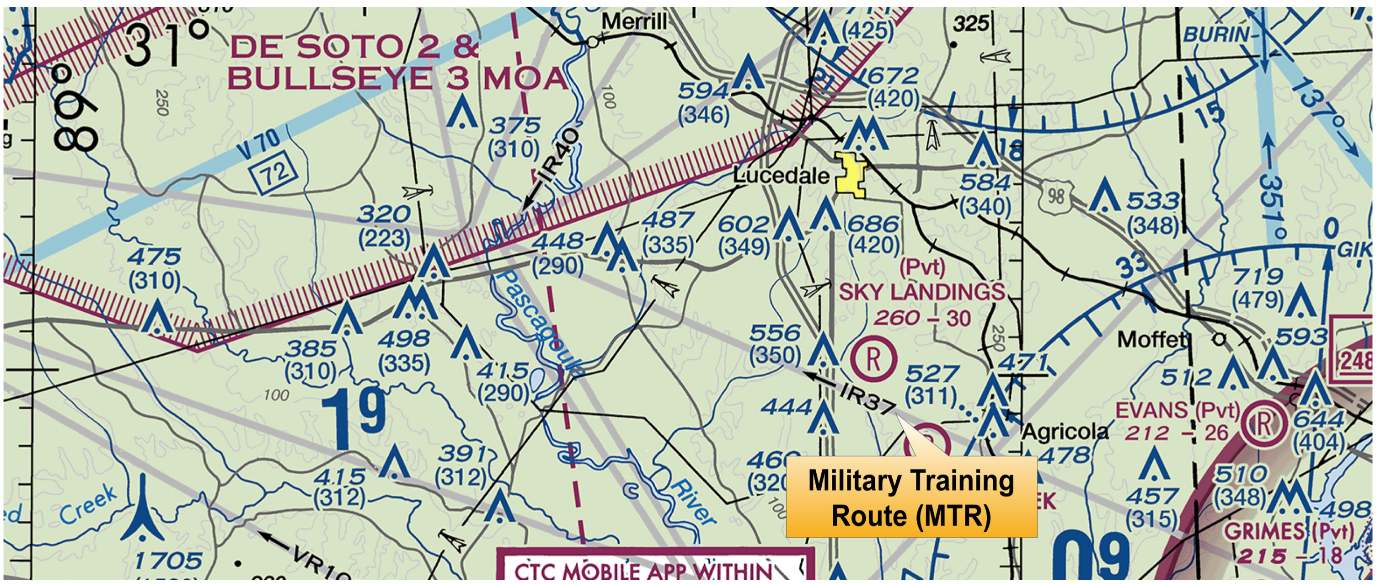


Figure 3–37: Military training route (MTR) chart symbols.

Temporary Flight Restrictions (TFR)

A flight data center (FDC) Notice to Airmen (NOTAM) is issued to designate a TFR. The NOTAM begins with the phrase "FLIGHT RESTRICTIONS," followed by the location of the temporary restriction, effective time period, area defined in statute miles, and altitudes affected. The NOTAM also contains the FAA coordination facility and telephone number, the reason for the restriction, and any other information deemed appropriate. The pilot should check the NOTAMs as part of flight planning.

Some of the purposes for establishing a TFR are:

- Protect persons and property in the air or on the surface from an existing or imminent hazard.
- Provide a safe environment for the operation of disaster relief aircraft.
- Prevent an unsafe congestion of sightseeing aircraft above an incident or event that may generate a high degree of public interest.
- Protect declared national disasters for humanitarian reasons in the State of Hawaii.
- Protect the President, Vice President, or other public figures.
- Provide a safe environment for space agency operations.

Since the events of September 11, 2001, the use of TFRs has become much more common. There have been a number of incidents of aircraft incursions into TFRs that have resulted in pilots undergoing security investigations and certificate suspensions. It is a pilot's responsibility to be aware of TFRs in their proposed area of flight. One way to check is to visit the FAA website, www.tfr.faa.gov, and verify that there is not a TFR in the area.

Parachute Jump Aircraft Operations

Parachute jump aircraft operations are published in the Chart Supplement U.S. (formerly Airport/Facility Directory). Sites that are used frequently are depicted on sectional charts.

Published VFR Routes

Published VFR routes are for transitioning around, under, or through some complex airspace. Terms such as VFR flyway, VFR corridor, Class B airspace VFR transition route, and terminal area VFR route have been applied to such routes. These routes are generally found on VFR terminal area planning charts.

Terminal Radar Service Areas (TRSAs)

TRSAs are areas where participating pilots can receive additional radar services. The purpose of the service is to provide separation between all IFR operations and participating VFR aircraft.

The primary airport(s) within the TRSA become(s) Class D airspace. The remaining portion of the TRSA overlies another controlled airspace, which is normally Class E airspace beginning at 700 or 1,200 feet and established to transition to/ from the en route/terminal environment. TRSAs are depicted on VFR sectional charts and terminal area charts with a solid black line and altitudes for each segment. The Class D portion is charted with a blue segmented line. Participation in TRSA services is voluntary; however, pilots operating under VFR are encouraged to contact the radar approach control and take advantage of TRSA service.

National Security Areas (NSAs)

NSAs consist of airspace of defined vertical and lateral dimensions established at locations where there is a requirement for increased security and safety of ground facilities. Flight in NSAs may be temporarily prohibited by regulation under the provisions of Title 14 of the Code of Federal Regulations (14 CFR) part 99, and prohibitions are disseminated via NOTAM. Pilots are requested to avoid flying through these depicted areas voluntarily.

Air Traffic Control and the National Airspace System

The primary purpose of the ATC system is to prevent a collision between aircraft operating in the system and to organize and expedite the flow of traffic. In addition to its primary function, the ATC system has the capability to provide (with certain limitations) additional services. The ability to provide additional services is limited by many factors, such as the volume of traffic, frequency congestion, quality of radar, controller workload, higher priority duties, and the pure physical inability to scan and detect those situations that fall in this category. It is recognized that these services cannot be provided in cases in which the provision of services is precluded by the above factors.

Consistent with the aforementioned conditions, controllers shall provide additional service procedures to the extent permitted by higher priority duties and other circumstances. The provision of additional services is not optional on the part of the controller but rather is required when the work situation permits. Provide ATC service in accordance with the procedures and minima in this order except when other procedures/minima are prescribed in a letter of agreement, FAA directive, or a military document.

Operating Rules and Pilot/Equipment Requirements

The safety of flight is a top priority of all pilots, and the responsibilities associated with operating an aircraft should always be taken seriously. The air traffic system maintains a high degree of safety and efficiency with strict regulatory oversight of the FAA. Pilots fly in accordance with regulations that have served the United States well, as evidenced by the fact that the country has the safest aviation system in the world.

All aircraft operating in today's National Airspace System (NAS) has complied with the CFR governing its certification and maintenance; all pilots operating today have completed rigorous pilot certification training and testing. Of equal importance are the proper execution of preflight planning, aeronautical decision-making (ADM) and risk management. ADM involves a systematic approach to risk assessment and stress management in aviation, illustrates how personal attitudes can influence decision-making, and how those attitudes can be modified to enhance safety. More detailed information regarding ADM and risk mitigation can be found in Chapter 10, "Aeronautical Decision- Making and Judgment," of this study guide.

Pilots also comply with very strict FAA general operating and flight rules as outlined in the CFR, including the FAA's important "see and avoid" mandate. These regulations provide the historical foundation of the FAA regulations governing the aviation system and the individual classes of airspace.

Visual Flight Rules (VFR) Terms and Symbols

Remote pilots need to be familiar with the following information from the ***FAA Aeronautical Chart User's Guide***[1] website:

- » All information on the VFR Terms tab
- » The following sections under "VFR Aeronautical Chart Symbols" on the VFR Symbols tab:
    - » Airports
    - » Airspace Information
    - » Navigational and Procedural Information
    - » Chart Limits
    - » Culture
    - » Hydrography
    - » Relief

1 URL: https://www.faa.gov/air_traffic/flight_info/aeronav/digital_products/aero_guide/

Sample Questions

Readers may locate the answers to the following questions in Appendix A. The sample questions in this book sometimes refer to figures from the ***FAA-CT-8080-2H Airman Knowledge Testing Supplement***. [1]

3001. (**Refer to Figure 20**, area 2.) Why would the small flag at Lake Drummond of the sectional chart be important to a remote pilot?

A. This is a VFR checkpoint for manned aircraft, and a higher volume of air traffic should be expected there.

B. This is a GPS checkpoint that can be used by both manned and remote pilots for orientation.

C. This indicates that there will be a large obstruction depicted in the next printing of the chart.

3002. What is the maximum allowable groundspeed for a UAV beneath Class B airspace?

A. 87 knots.

B. 90 knots.

C. 100 knots.

3003. (**Refer to Figure 20**, area 3.) With ATC authorization, you are operating your small unmanned aircraft approximately 4 SM southeast of Elizabeth City Regional Airport (ECG). What hazard is indicated to be in that area?

A. High-density military operations in the vicinity.

B. Unmarked balloon on a cable up to 3,008 feet AGL.

C. Unmarked balloon on a cable up to 3,008 feet MSL.

3004. (**Refer to Figure 78**.) You have been hired to use your small UAS to inspect the railroad tracks from Blencoe (SE of Sioux City) to Onawa. Will ATC authorization be required?

A. Yes, Onawa is in the Class D airspace that is designated for an airport.

B. No, your entire flight is in Class G airspace.

C. Yes, you must contact the Onawa control tower to operate within 5 miles of the airport.

3005. (**Refer to Figure 20**, area 3.) Determine the approximate latitude and longitude of Currituck County Airport.

A. 36°24’N - 76°01’W.

B. 36°48’N - 76°01’W.

C. 47°24’N - 75°58’W.

1 URL: https://www.amazon.com/FAA-CT-8080-2H-Knowledge-Testing-Supplement-Recreational/dp/1674175949/

3006. (**Refer to Figure 26**, area 3.) When flying over Arrowwood National Wildlife Refuge, a pilot should fly no lower than

A. 2,000 feet AGL.

B. 2,500 feet AGL.

C. 3,000 feet AGL.

3007. With certain exceptions, Class E airspace extends upward from either 700 feet or 1,200 feet AGL to, but does not include,

A. 10,000 feet MSL.

B. 14,500 feet MSL.

C. 18,000 feet MSL.

3008. (**Refer to Figure 25**, area 4.) The airspace directly overlying Fort Worth Meacham is

A. Class B airspace to 10,000 feet MSL.

B. Class C airspace to 5,000 feet MSL.

C. Class D airspace to 3,200 feet MSL.

3009. (**Refer to Figure 24**, area 3.) For information about the parachute operations at Tri-County Airport, refer to

A. notes on the border of the chart.

B. Chart Supplements U.S.

C. the Notices to Airmen (NOTAM) publication.

3010. (**Refer to Figure 21**.) The terrain elevation of the light tan area between Minot (area 1) and Audubon Lake (area 2) varies from

A. sea level to 2,000 feet MSL.

B. 2,000 feet to 2,500 feet MSL.

C. 2,000 feet to 2,700 feet MSL.

3011. (**Refer to Figure 22**, area 3.) Determine the approximate latitude and longitude of Shoshone County Airport.

A. 47°02'N - 116°11'W.

B. 47°33'N - 116°11'W.

C. 47°32'N - 116°41'W.

3012. (**Refer to Figure 78**.) What class of airspace is associated with SIOUX GATEWAY/COL DAY (SUX) Airport?

A. Class B airspace.

B. Class C airspace.

C. Class D airspace.

3013. Information concerning parachute jumping sites may be found in the

A. NOTAMs.

B. Chart Supplement.

C. Graphic Notices and Supplemental Data.

3014. Pilots flying over a national wildlife refuge are requested to fly no lower than

A. 1,000 feet AGL.

B. 2,000 feet AGL.

C. 3,000 feet AGL.

3015. (**Refer to Figure 20**, area 2.) The elevation of the Chesapeake Regional Airport is

A. 19 feet.

B. 36 feet.

C. 360 feet.

3016. The width of a Federal Airway from either side of the centerline is

A. 4 nautical miles.

B. 6 nautical miles.

C. 8 nautical miles.

3017. (**Refer to Figure 59**, area 2.) The chart shows a gray line with “VR1667, VR1617, VR1638, and VR1668.” Could this area present a hazard to the operations of a small UA?

A. No, all operations will be above 400 feet.

B. Yes, this is a Military Training Route from the surface to 1,500 feet AGL.

C. Yes, the defined route provides traffic separation to manned aircraft.

3018. (**Refer to Figure 26**, area 2.) What is the approximate latitude and longitude of Cooperstown Airport?

A. 47°25’N - 98°06’W.

B. 47°25’N - 99°54’W.

C. 47°55’N - 98°06’W.

3019. The purpose of Military Training Routes charted as VFR Military Training Routes (VR) and IFR Military Training Routes (IR) on sectional charts, is to ensure the greatest practical level of safety for all flight operations and to allow the military to conduct

A. low altitude, high-speed training.

B. radar instrument training.

C. air-to-air refueling training.

3020. According to 14 CFR part 107 the remote pilot in command (PIC) of a small unmanned aircraft planning to operate within Class C airspace

A. must use a visual observer.

B. is required to file a flight plan.

C. is required to receive ATC authorization.

3021. (**Refer to Figure 26**, area 1.) Identify the airspace over Tomlinson Airport (8J7).

A. Class G airspace - surface up to but not including 1,200 feet AGL, Class E airspace - 1,200 feet AGL up to but not including 18,000 feet MSL.

B. Class G airspace - surface up to but not including 18,000 feet MSL.

C. Class G airspace - surface up to but not including 700 feet MSL, Class E airspace - 700 feet to 14,500 feet MSL.

3022. (**Refer to Figure 75**, area 6.) During preflight planning, you plan to operate in R-2305. Where would you find additional information regarding this airspace?

A. In the Aeronautical Information Manual.

B. In the Charts Supplements U.S.

C. In the Special Use Airspace area of the chart.

3023. (**Refer to Figure 21**, area 3.) Which airport is located at approximately 47°21'N latitude and 101°01'W longitude?

A. Underwood.

B. Evenson.

C. Washburn.

3024. Flight through a restricted area should not be accomplished unless the remote pilot has

A. filed an IFR flight plan.

B. received prior authorization from the controlling agency.

C. received prior permission from the commanding officer of the nearest military base.

3025. (**Refer to Figure 26**.) What does the line of latitude at area 4 measure?

A. The degrees of latitude east and west of the Prime Meridian.

B. The degrees of latitude north and south from the equator.

C. The degrees of latitude east and west of the line that passes through Greenwich, England.

3026. Responsibility for collision avoidance in an alert area rests with

A. the controlling agency.

B. all pilots.

C. Air Traffic Control.

3027. (**Refer to Figure 20** area 4.) What hazards to aircraft may exist in restricted areas such as R-5302B?

A. Unusual, often invisible, hazards such as aerial gunnery or guided missiles.

B. Military training activities that necessitate acrobatic or abrupt flight maneuvers.

C. A high volume of pilot training or an unusual type of aerial activity.

3028. The vertical limit of Class C airspace above the primary airport is normally

A. 1,200 feet AGL.

B. 3,000 feet AGL.

C. 4,000 feet AGL.

3029. (**Refer to Figure 25**, area 4.) The floor of Class B airspace overlying Hicks Airport (T67) north-northwest of Fort Worth Meacham Field is

A. at the surface.

B. 3,200 feet MSL.

C. 4,000 feet MSL.

3030. Under which conditions may a pilot fly under VFR within 60 nautical miles of the DCA VOR in Washington, D.C.?

A. None.

B. Only if the pilot has completed special awareness training and filed a flight plan.

C. As long as the pilot has completed special awareness training and remains clear of the SFRA.

3031. (**Refer to Figure 20**, area 1.) The NALF Fentress (NFE) Airport is in what type of airspace?

A. Class C.

B. Class E.

C. Class G.

3032. (**Refer to Figure 20**, area 5.) How would a remote PIC "CHECK NOTAMS" as noted in the CAUTION box regarding the unmarked balloon?

A. By utilizing the B4UFLY mobile application.

B. By contacting the FAA district office.

C. By obtaining a briefing via an online source such as 1800WXBrief.com.

3033. (**Refer to Figure 26**, area 4.) You have been hired to inspect the tower under construction at 46.9N and 98.6W, near Jamestown Regional (JMS). What must you receive prior to flying your unmanned aircraft in this area?

A. Authorization from the military.

B. Authorization from ATC.

C. Authorization from the National Park Service.

3034. (**Refer to Figure 25**, area 3.) The floor of Class B airspace at Dallas Executive (RBD) is

A. at the surface.

B. 3,000 feet MSL.

C. 3,100 feet MSL.

3035. (**Refer to Figure 21**, area 1.) After receiving authorization from ATC to operate a small UA near Minot International airport (MOT) while the control tower is operational, which radio communication frequency could be used to monitor manned aircraft and ATC communications?

A. UNICOM 122.95.

B. ASOS 118.725.

C. CT-118.2.

3036. What action should a remote pilot take when operating in a Military Operations Area (MOA)?

A. Obtain clearance from the controlling agency prior to entering the MOA.

B. Operate only on the airways that transverse the MOA.

C. Exercise extreme caution when military activity is being conducted.

3037. (**Refer to Figure 20**, area 5.) The CAUTION box denotes what hazard to aircraft?

A. Unmarked balloon on a cable to 3,008 feet MSL.

B. Unmarked balloon on a cable to 3,008 feet AGL.

C. Unmarked blimp hangars at 300 feet MSL.

3038. Unless otherwise specified, Federal Airways include that Class E airspace extending upward from

A. 700 feet above the surface up to and including 17,999 feet MSL.

B. 1,200 feet above the surface up to and including 17,999 feet MSL.

C. the surface up to and including 18,000 feet MSL.

3039. (**Refer to Figure 23**.) The flag symbols at Statesboro Bulloch County Airport, Claxton-Evans County Airport and Ridgeland Airport are

A. outer boundaries of Savannah Class C airspace.

B. airports with special traffic patterns.

C. visual checkpoints to identify the position for initial call-up prior to entering Savannah Class C airspace.

3040. (**Refer to Figure 23**, area 3.) What is the floor of the Savannah Class C airspace at the shelf area (outer circle)?

A. 1,300 feet AGL.

B. 1,300 feet MSL.

C. 1,700 feet MSL.

3041. A blue segmented circle on a Sectional Chart depicts which class airspace?

A. Class B.

B. Class C.

C. Class D.

3042. Which is true concerning the blue and magenta colors used to depict airports on Sectional Aeronautical Charts?

A. Airports with control towers underlying Class A, B, and C airspace are shown in blue; Class D and E airspace are magenta.

B. Airports with control towers underlying Class C, D, and E airspace are shown in magenta.

C. Airports with control towers underlying Class B, C, D, and E airspace are shown in blue.

3043. (**Refer to Figure 25**, area 7.) The airspace overlying McKinney (TKI) is controlled from the surface to

A. 2,900 feet MSL.

B. 2,500 feet MSL.

C. 700 feet AGL.

3044. The lateral dimensions of Class D airspace are based on

A. the number of airports that lie within the Class D airspace.

B. 5 statute miles from the geographical center of the primary airport.

C. the instrument procedures for which the controlled airspace is established.

3045. (**Refer to Figure 25**, area 2.) The control tower frequency for Addison Airport is

A. 122.95 MHz.

B. 126.0 MHz.

C. 133.4 MHz.

3046. (**Refer to Figure 20**, area 4.) A small UA is being launched 2 NM northeast of the town of Hertford. What is the height of the highest obstacle?

A. 399 feet MSL.

B. 500 feet MSL.

C. 500 feet AGL.

3047. (**Refer to Figure 20**, area 2.) The flag symbol at Lake Drummond represents a

A. compulsory reporting point for Norfolk Class C airspace.

B. compulsory reporting point for Hampton Roads Airport.

C. visual checkpoint used to identify the position for an initial callup to Norfolk Approach Control.

3048. The VFR pilot flying in Class G airspace

A. has tighter cloud and visibility restrictions because IFR aircraft flying in Class G airspace do not have air traffic control service.

B. has no cloud and visibility restrictions because IFR operations are prohibited in Class G airspace.

C. has reduced cloud and visibility restrictions because it's unlikely that IFR traffic will be operating in Class G airspace.

3049. According to 14 CFR part 107, how may a remote pilot operate an unmanned aircraft in Class C airspace?

A. The remote pilot must have prior authorization from the Air Traffic Control (ATC) facility having jurisdiction over that airspace.

B. The remote pilot must monitor the Air Traffic Control (ATC) frequency from launch to recovery.

C. The remote pilot must contact the Air Traffic Control (ATC) facility after launching the unmanned aircraft.

3050. (**Refer to Figure 23**, area 3.) The top of the group obstruction approximately 11 nautical miles from the Savannah VORTAC on the 007° radial is

A. 253 feet AGL.

B. 454 feet MSL.

C. 417 feet MSL.

3051. (**Refer to Figure 21**, area 2.) Which airport is located at approximately 47°34’30”N latitude and 100°44’00”W longitude?

A. Turtle Lake.

B. Makeeff.

C. Johnson.

3052. Which statement about longitude and latitude is true?

A. Lines of longitude are parallel to the Equator.

B. Lines of longitude cross the Equator at right angles.

C. The 0° line of latitude passes through Greenwich, England.

3053. (**Refer to Figure 25**, area 2.) The floor of Class B airspace at Air Park-Dallas Airport is

A. at the surface.

B. 3,000 feet MSL.

C. 3,100 feet MSL.

3054. You know when looking at a chart that the floor of Class E airspace is 700 feet AGL when it’s within

A. the fuzzy side of the blue vignette.

B. the fuzzy side of the magenta vignette.

C. the magenta dashed line.

3055. (**Refer to Figure 21**.) What airport is located approximately 47 (degrees) 40 (minutes) N latitude and 101 (degrees) 26 (minutes) W longitude?

A. Mercer County Regional Airport.

B. Semshenko Airport.

C. Garrison Airport.

3056. The normal radius of the procedural Outer Area of Class C airspace is normally

A. 10 nautical miles.

B. 30 nautical miles.

C. 20 nautical miles.

3057. (**Refer to Figure 24**, area 1.) For information about the parachute jumping at Caddo Mills Airport, refer to

A. notes on the border of the chart.

B. the Chart Supplement.

C. the Notices to Airmen (NOTAM) publication.

3058. (**Refer to Figure 26**, area 5.) The airspace overlying and within 5 miles of Barnes County Airport is

A. Class D airspace from the surface to the floor of the overlying Class E airspace.

B. Class E airspace from the surface to 1,200 feet MSL.

C. Class G airspace from the surface to 700 feet AGL.

3059. One of the purposes for issuing a Temporary Flight restriction (TFR) is to

A. announce Parachute Jump Areas.

B. protect public figures.

C. identify Airport Advisory Areas.

3060. (**Refer to Figure 24**, area 6.) What type of airport is Card Airport?

A. Public towered.

B. Public non-towered.

C. Private non-towered.

Chapter 4: Airport Operations

To prevent runway incursions, the FAA has standardized many of the airport operations, such as markings, signs, and radio communication procedures. The FAA wants remote pilots to understand this information so that they maintain situational awareness when operating near an airport or in controlled airspace.

Airport Markings and Signs

Airports have signs at taxiways and runways as well as markings on the pavement on and near runways. The following are several types of signs and markings that remote pilots should understand. Readers should memorize the look and purpose of each of these signs and markings:

- Taxiway direction signs
- Destination signs
- Outbound runway destination signs
- Taxiway location signs
- Runway location signs
- ILS (Instrument Landing System) Critical Area Boundary Signs
- Runway hold position sign
- No entry signs
- Taxiway ending markers
- Runway hold position markings
- Enhanced taxiway centerlines
- Roadway-type markings
- Closed runway markings
- Displaced threshold markings
- Emergency overrun area markings
- Demarkation bars

A **Taxiway direction sign** tells pilots the name of the intersecting taxiway and what direction to turn to get on that taxiway. [**Figure 4–1**]

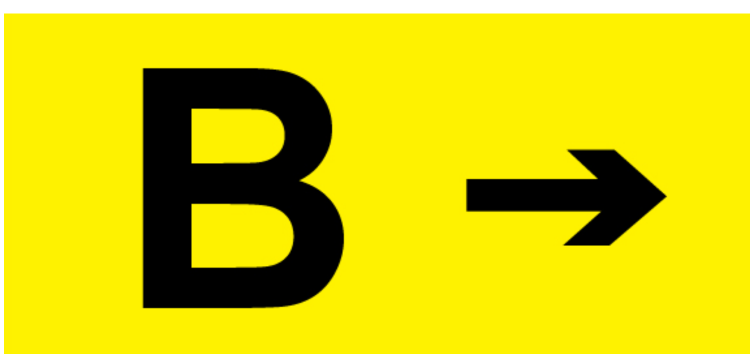


Figure 4–1: Taxiway direction sign.

A **taxiway destination sign** tells pilots how to get to specific places at the airport.[**Figure 4–2**]

Figure 4–2: Destination sign.

Outbound runway destination signs tell pilots how to get to a runway. [**Figure 4–3**]

Figure 4–3: Outbound runway destination sign

Taxiway location signs tell pilots on which taxiway they are currently located. [Figure 4–4]

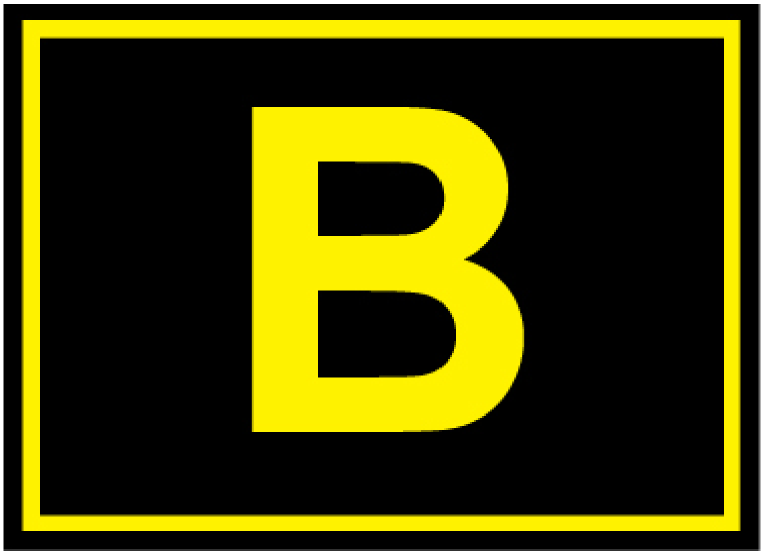


Figure 4–4: Taxiway location sign

Runway location signs tell pilots on which runway they are currently located. [**Figure 4–5**]

Figure 4–5: Runway location sign

ILS (Instrument Landing System) Critical Area Boundary Signs identifies the area near the runway that is a boundary where there are electronic signals that pilots use.[**Figure 4–6**]

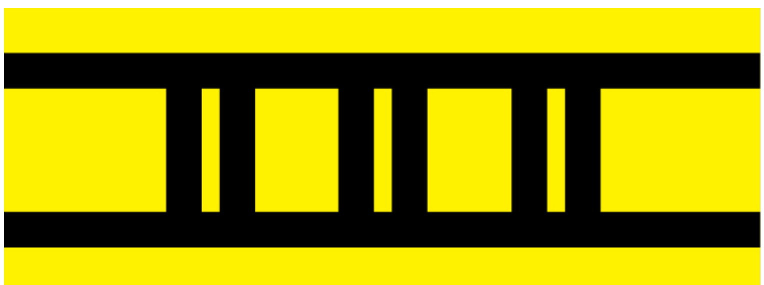


Figure 4–6: ILS (Instrument Landing System) Critical Area Boundary Sign

Runway hold position signs tell pilots to stop and hold until they receive clearance from air traffic control. [**Figure 4–7**] For airports without a control tower, pilots should stop and check that the area is clear.

Figure 4–7: Runway hold position sign

No entry signs indicate that pilots may not taxi. [**Figure 4–8**] Pilots will see this sign in paved areas where aircraft are prohibited.

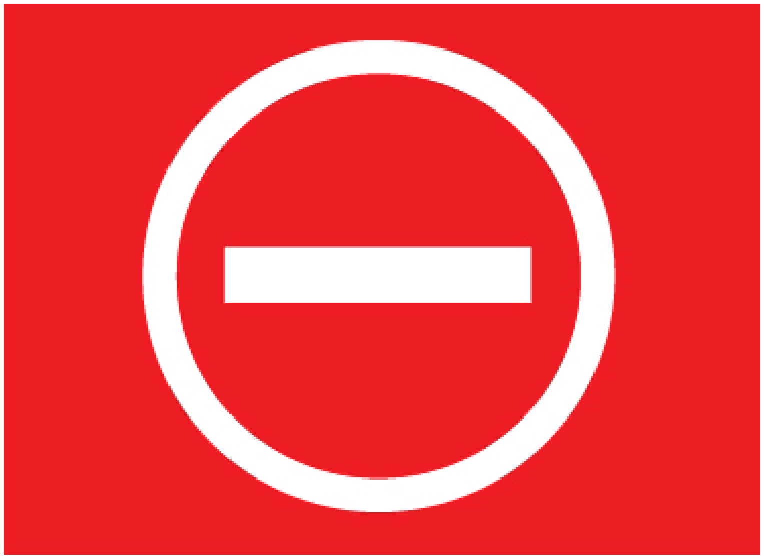


Figure 4–8: No entry sign

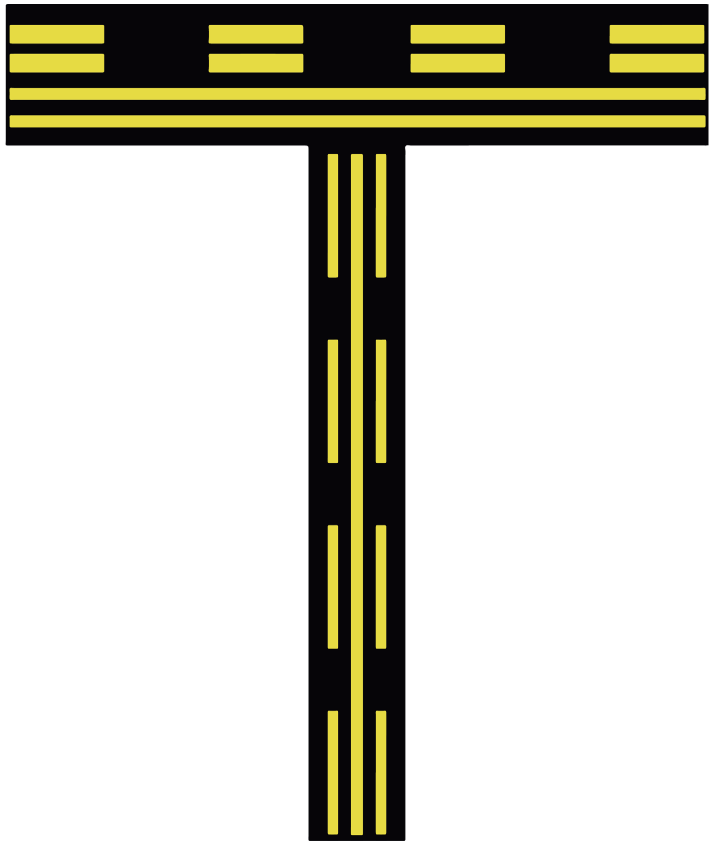
Taxiway ending markers appear on pavement and indicate where the taxiway does not continue. [**Figure 4–9**]

Figure 4–9: Taxiway ending marker

Runway hold position markings show four yellow signs against the pavement background. Two lines are solid, and two lines are dashed. The solid lines are always located away from the runway and indicate that pilots should stop and hold until they receive clearance from air traffic control. [**Figure 4–10**] For airports without a control tower, pilots should stop and check that the runway is clear. The dashed lines are always located nearest the runway. Pilots may cross the dashed lines to exit the runway at any time without permission from ATC. The aircraft is not clear of the runway until the entire aircraft exits past the solid lines.

Figure 4–10: Runway hold position markings

Enhanced taxiway centerlines indicate to pilots that they are approaching the entrance to a runway and need to prepare to stop. They begin at a maximum of 150 feet from the runway hold line. [**Figure 4–11**]



Roadway-type markings indicate where ground vehicles travel through the aircraft movement area. [**Figure 4–12**]

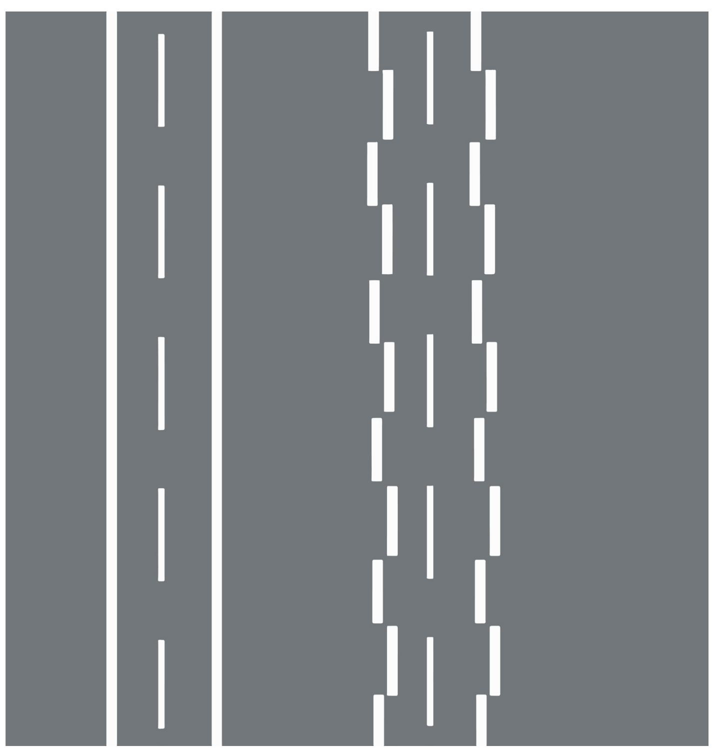


Figure 4–12: Roadway-type markings

Closed runway markings appear as Xs painted on the runway. [**Figure 4–13**] If the runway numbers are still present, it could mean that the runway is temporarily closed. The runway is permanently closed if the numbers are absent.

Figure 4–13: Closed runway markings

Displaced threshold markings appear as arrows preceding the runway number. [**Figure 4–14**] They indicate that the area is for taxi and takeoff only. Aircraft are not allowed to land in this area.

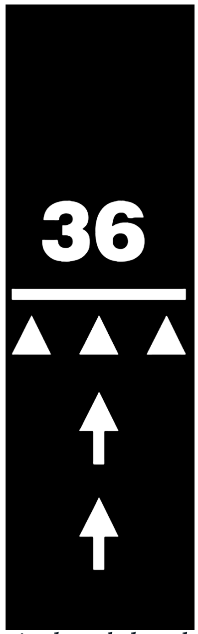


Figure 4–14: Displaced threshold markings

Emergency overrun area markings appear as chevron symbols at the end of a runway[**Figure 4–15**]. This area can only be used in emergencies while landing. The **demarcation bar** separates areas such as displaced thresholds, emergency overrun areas, or taxiways from the runway. [**Figure 4–15**]

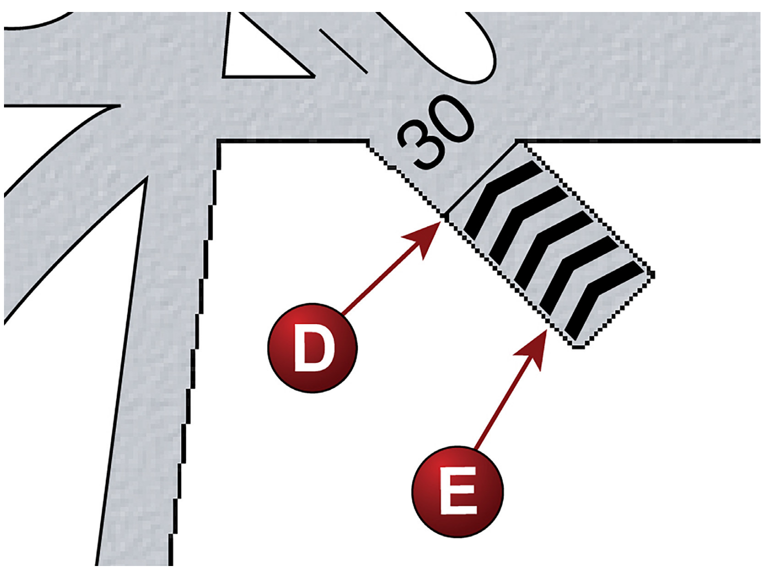


Figure 4–15: Emergency overrun area markings appear as chevron symbols, as indicated by area E. The letter D indicates the demarkation bar.

Runway Numbering

The numbering on the runway indicates the magnetic orientation of the runway to the nearest 10°. The number is abbreviated so that you must add a zero to the end of the number to get the azimuth in degrees. For example, the runway marked **36** in **Figure 4–16** indicates that a plane would land facing **360°** magnetic on takeoff and landing.

Wind Indicators

The FAA wants remote pilots to understand the symbols for wind indicators. Wind indicators tell pilots the direction the wind is blowing. Ideally, pilots should land into the wind. The symbols may include a tetrahedron [**Figure 4–16**] or a wind cone [**Figure 4–17**].

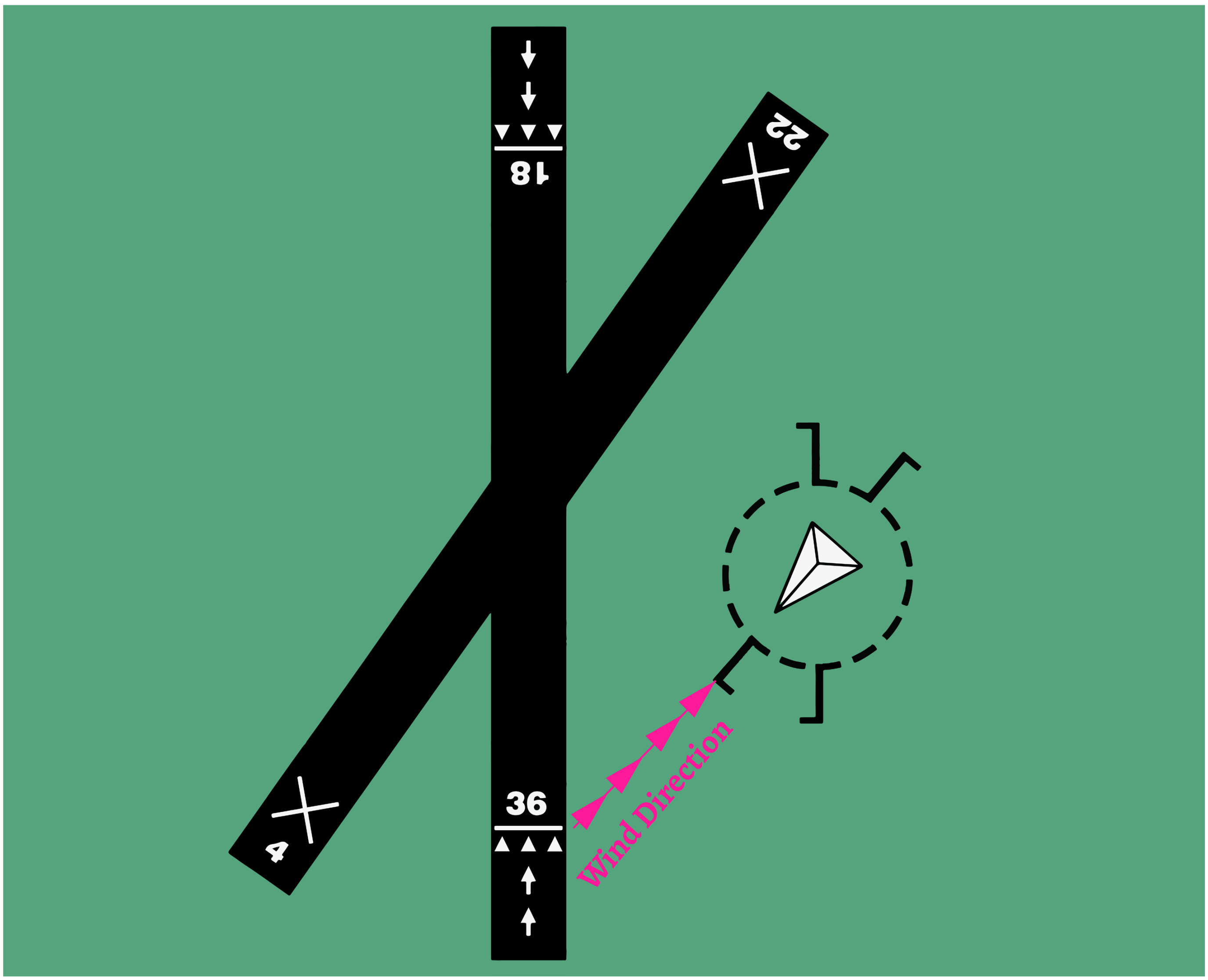


Figure 4–16: Like the nose of an aircraft, the tetrahedron points into the wind.

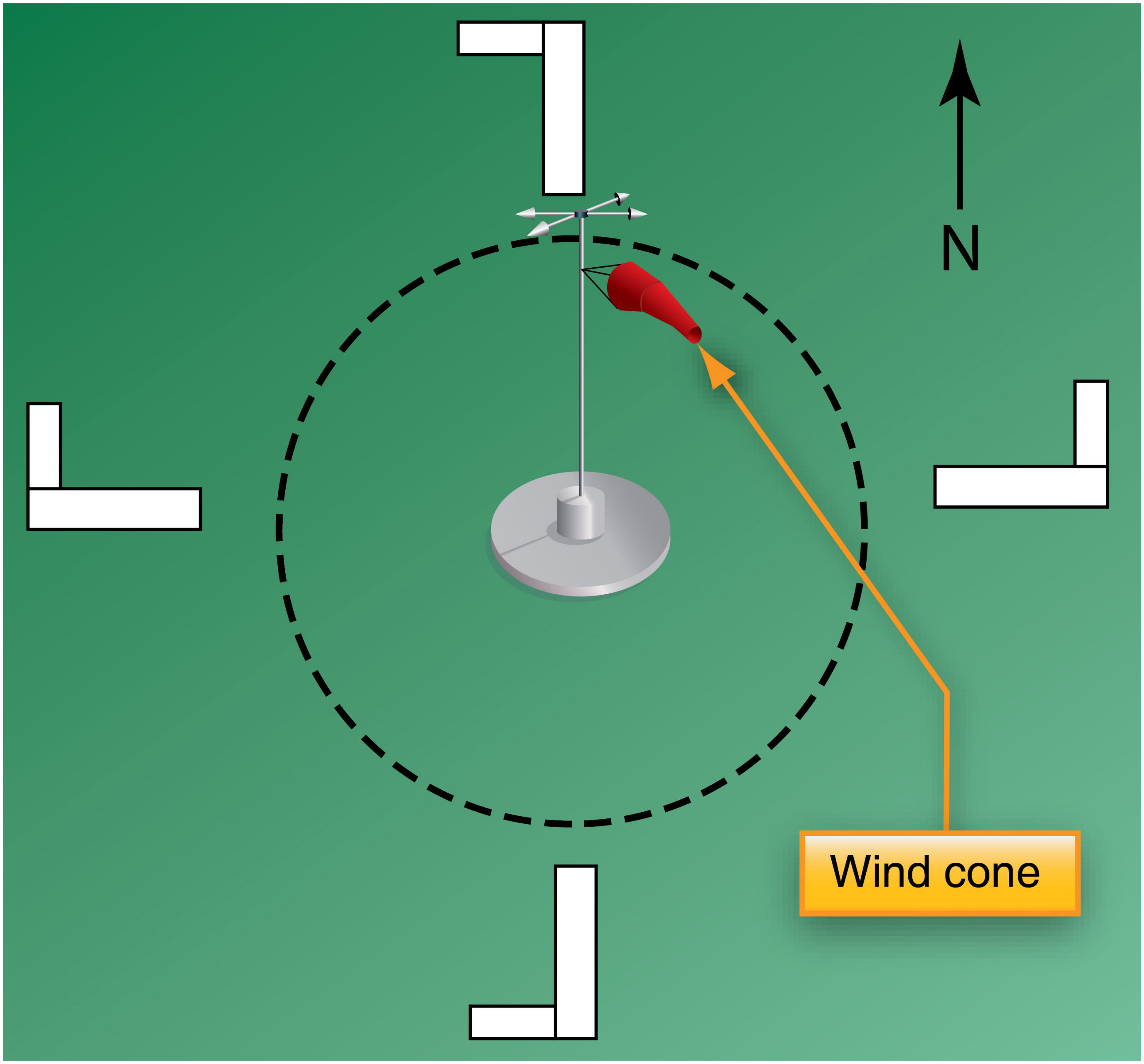


Figure 4–17: The wind cone catches the wind and points the direction the wind is blowing.

Traffic Pattern Indicators

When looking at a traffic pattern indicator [**Figure 4–17**], the white bars outside of the segmented circle indicate which direction aircraft will turn either after takeoff or before the final approach for landing. For example, an aircraft landing south-bound on **Figure 4–17** would make a right turn before the final approach to the runway. The FAA describes this as right-hand traffic. Alternatively, if a pilot were landing northbound, they would make a left-hand turn before the final approach to the runway. The FAA describes this as left-hand traffic. Readers may notice that the traffic pattern indicators in **Figure 4–17** keep traffic away from the area southeast of the airport. As a remote pilot, this information is useful for understanding where there will be traffic when flying near an airport. The recommended entry for an airport traffic pattern is on a **45°** angle at the **midpoint** of the runway on the **downwind leg**. Air traffic should enter the pattern at **traffic pattern altitude**.

The **Chart Supplement** is another source of traffic pattern information.

Reading the Chart Supplement U.S.

As you learned earlier, the **Chart Supplement U.S.** (formerly Airport/Facility Directory) provides the most comprehensive information on a given airport. It contains information on airports, heliports, and seaplane bases that are open to the public. The Chart Supplement U.S. is published in seven books, which are organized by regions and are revised every 56 days. The Chart Supplement U.S. is also available digitally at *www.faa.gov/air_traffic/flight_info/aeronav*. For a complete listing of information provided in a Chart Supplement U.S. and how the information may be decoded, refer to the "Legend Sample" located in the front of each Chart Supplement U.S. [**Figure 4–18**]

4 **DIRECTORY LEGEND**

SAMPLE

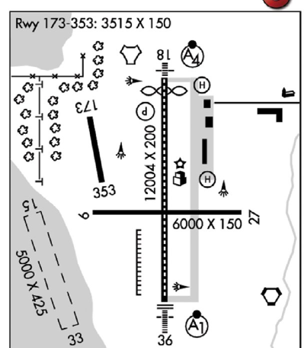
1 2 3 4 5 6 7 8

CITY NAME
AIRPORT NAME (ALTERNATE NAME) (LTS) (KLTS) CIV/MIL 3 N UTC–6(–5DT) N34°41.93′ W99°20.20′ **JACKSONVILLE**
200 B S4 **FUEL** 100 OX 1 TPA—1000(800) AOE Class IV, ARFF Index A NOTAM FILE ORL Not insp. **COPTER**
H–4G, L–19C
11 12 13 14 15 16 17 18 19 20 **IAP, DIAP, AD**
9

21 **RWY 18–36:** H12004X200 (ASPH–CONC–GRVD)
S–90, D–160, 2D–300 PCN 80 R/B/W/T HIRL CL
RWY 18: LDIN. MALSF. TDZL. REIL. PAPI(P2R)—GA 3.0° TCH 36′.
Thld dsplcd 300′. Trees. Rgt tfc. 0.3% up.
RWY 36: ALSF1. 0.4% down.
RWY 09–27: H6000X150 (ASPH) MIRL
RWY 173–353: H3515X150 (ASPH–PFC) AUW PCN 59 F/A/W/T
LAND AND HOLD SHORT OPERATIONS

LANDING	HOLD SHORT POINT	DIST AVBL
RWY 18	09–27	6500
RWY 36	09–27	5400

RUNWAY DECLARED DISTANCE INFORMATION
RWY 18: TORA–12004 TODA–12704 ASDA–11704 LDA–11504
RWY 36: TORA–12004 TODA–12004 ASDA–12004 LDA–11704
22 **ARRESTING GEAR/SYSTEM**
RWY 18 → HOOK E5 (65′ OVRN) BAK–14 BAK–12B (1650′)
BAK–14 BAK–12 (B) (1087′) HOOK E5 (74′ OVRN) ← **RWY 36**
23 **MILITARY SERVICE: A–GEAR** E–5 connected on dep end, disconnected on apch end. **JASU** 3(AM32A–60) 2(A/M32A–86)
24



10

25 **FUEL** J8(Mil) (NC–100, A) **FLUID** W SP PRESAIR LOX 26
OIL O–128 **TRAN ALERT** Avbl 1300–0200Z‡, svc limited weekends.
27 28

29 **AIRPORT REMARKS:** Special Air Traffic Rules—Part 93, see Regulatory Notices. Attended 1200–0300Z‡. Parachute Jumping. Deer invof arpt. Heavy jumbo jet training surface to 9000′. Twy A clsd indef. Flight Notification Service (ADCUS) avbl.
30 **MILITARY REMARKS: ANG** PPR/Official Business Only. Base OPS DSN 638–4390, C503–335–4222. Ctc Base OPS 15 minutes prior to ldg and after dep. Limited tran parking.
31 **WEATHER DATA SOURCES:** AWOS–1 120.3 (202) 426–8000. LLWAS.
32 **COMMUNICATIONS: SFA** **ATIS** 127.25 273.5 (202) 426–8003 **UNICOM** 122.95 **PTD** 372.2
NAME FSS (ORL) on arpt. 123.65 122.65 122.2
NAME RCO 112.2T 112.1R (NAME RADIO)
Ⓡ **NAME APP/DEP CON** 128.35 257.725 (1200–0400Z‡)
TOWER 119.65 255.6 (1200–0400Z‡) **GND CON** 121.7 **GCO** 135.075 (ORLANDO CLNC) **CLNC DEL** 125.55
NAME COMD POST (GERONIMO) 311.0 321.4 6761 **PMSV METRO** 239.8 **NAME OPS** 257.5
33 **AIRSPACE: CLASS B** See VFR Terminal Area Chart.
34 **RADIO AIDS TO NAVIGATION:** NOTAM FILE ORL. VHF/DF ctc FSS.
(H) VORTAC 112.2 MCO Chan 59 N28°32.55′ W81°20.12′ at fld. 1110/8E.
(H) TACAN Chan 29 CBU (109.2) N28°32.65′ W81°21.12′ at fld. 1115/8E.
HERNY NDB (LOM) 221 OR N28°37.40′ W81°21.05′ 177° 5.4 NM to fld.
ILS/DME 108.5 I–ORL Chan 22 Rwy 18. Class IIE. LOM HERNY NDB.
ASR/PAR (1200–0400Z‡)
35 **COMM/NAV/WEATHER REMARKS:** Emerg frequency 121.5 not avbl at twr.

HELIPAD H1: H100X75 (ASPH)
HELIPAD H2: H60X60 (ASPH)
HELIPORT REMARKS: Helipad H1 lctd on general aviation side and H2 lctd on air carrier side of arpt.
1

187 TPA 1000(813)
WATERWAY 15–33: 5000X425 (WATER)
SEAPLANE REMARKS: Birds roosting and feeding areas along river banks. Seaplanes operating adjacent to SW side of arpt not visible from twr and are required to ctc twr.

All bearings and radials are magnetic unless otherwise specified.
All mileages are nautical unless otherwise noted.
All times are Coordinated Universal Time (UTC) except as noted.
All elevations are in feet above/below Mean Sea Level (MSL) unless otherwise noted.
The horizontal reference datum of this publication is North American Datum of 1983 (NAD83), which for charting purposes is considered equivalent to World Geodetic System 1984 (WGS 84).

NE, 09 FEB 20XX to 05 APR 20XX

Figure 4–18: Chart Supplement Legend Sample

The directory legend sample provides a sample airport facility directory entry with every part labeled with numbers. [**Figure 4–19**]The subsequent pages in the Chart Supplement provide the details and explanations about the type of information provided.

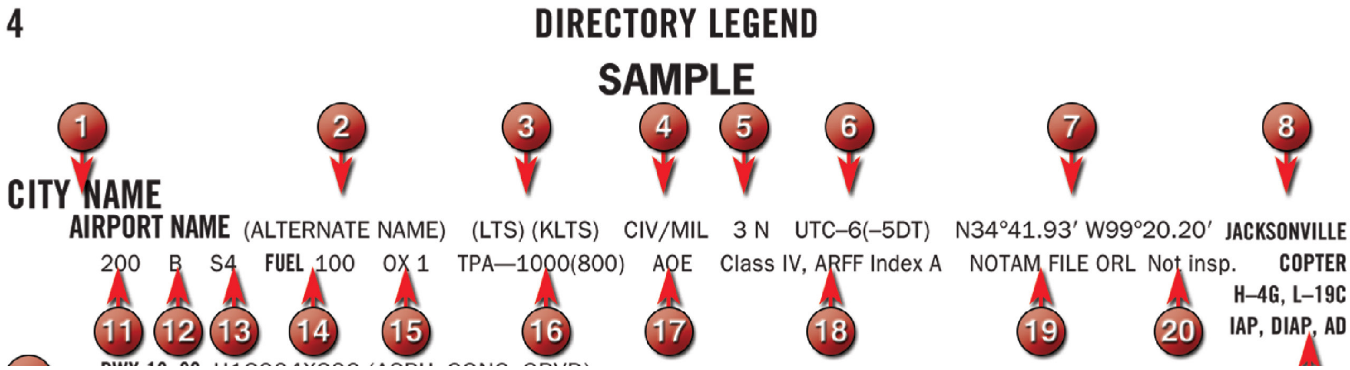
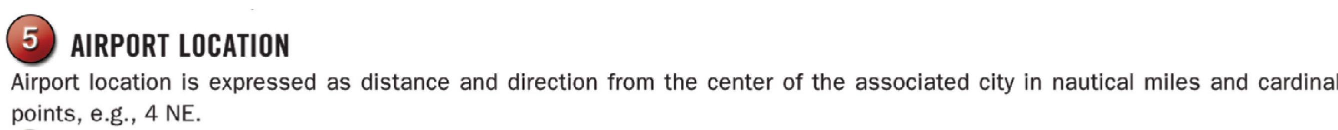


Figure 4–19: The numbers refer to explanations about different elements of an airport facility directory entry.

For example, number 3 in **Figure 4–19** indicates the identification code of the airport. Within the parenthesis, the letter K, which is the country code for the United States, precedes the three-letter airport code. Number 4 in **Figure 4–19** indicates the civilian or military status of the airport. Number 5 in **Figure 4–19** indicates the distance (in miles) and the direction of the airport relative to the city or town on which the name is based. Explanations for this type of information can be found on subsequent pages in the Chart Supplement legend. [**Figure 4–20**]

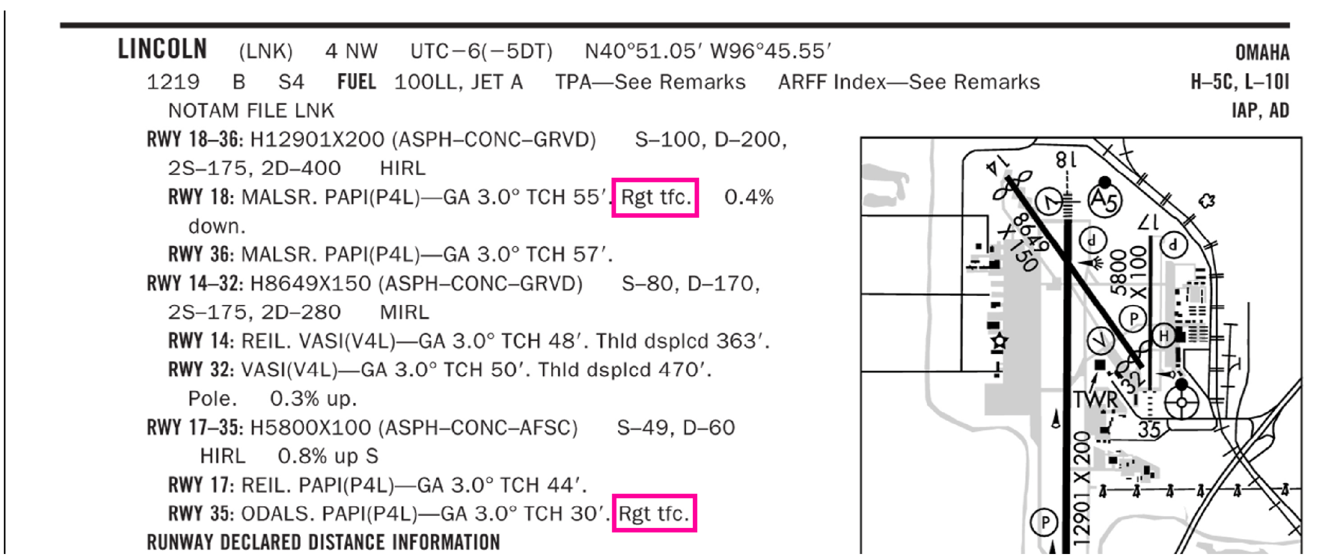


5 AIRPORT LOCATION

Airport location is expressed as distance and direction from the center of the associated city in nautical miles and cardinal points, e.g., 4 NE.

Figure 4–20: An explanation of item number 5 on the Directory Legend Sample.

The Chart Supplement also provides information on the runway traffic patterns. **Left-hand traffic** is the **default** traffic pattern. If there is no runway traffic pattern information on the Chart Supplement, then pilots can assume that the runway has a left-hand traffic pattern. The Chart Supplement indicates runways with a right-hand traffic pattern using the abbreviation "**Rgt tfc**." [**Figure 4–21**]



LINCOLN (LNK) 4 NW UTC–6(–5DT) N40°51.05′ W96°45.55′ OMAHA
1219 B S4 FUEL 100LL, JET A TPA—See Remarks ARFF Index—See Remarks H–5C, L–10I
NOTAM FILE LNK IAP, AD
RWY 18–36: H12901X200 (ASPH–CONC–GRVD) S–100, D–200, 2S–175, 2D–400 HIRL
RWY 18: MALSR. PAPI(P4L)—GA 3.0° TCH 55′. Rgt tfc. 0.4% down.
RWY 36: MALSR. PAPI(P4L)—GA 3.0° TCH 57′.
RWY 14–32: H8649X150 (ASPH–CONC–GRVD) S–80, D–170, 2S–175, 2D–280 MIRL
RWY 14: REIL. VASI(V4L)—GA 3.0° TCH 48′. Thld dsplcd 363′.
RWY 32: VASI(V4L)—GA 3.0° TCH 50′. Thld dsplcd 470′. Pole. 0.3% up.
RWY 17–35: H5800X100 (ASPH–CONC–AFSC) S–49, D–60 HIRL 0.8% up S
RWY 17: REIL. PAPI(P4L)—GA 3.0° TCH 44′.
RWY 35: ODALS. PAPI(P4L)—GA 3.0° TCH 30′. Rgt tfc.
RUNWAY DECLARED DISTANCE INFORMATION

Figure 4–21: Runway 18 and runway 35 have right-hand traffic.

Rotating Beacons and Fuel

An airport symbol with a tick mark on the top, bottom, and sides indicate that the airport has fuel service. [**Figure 4–22**]

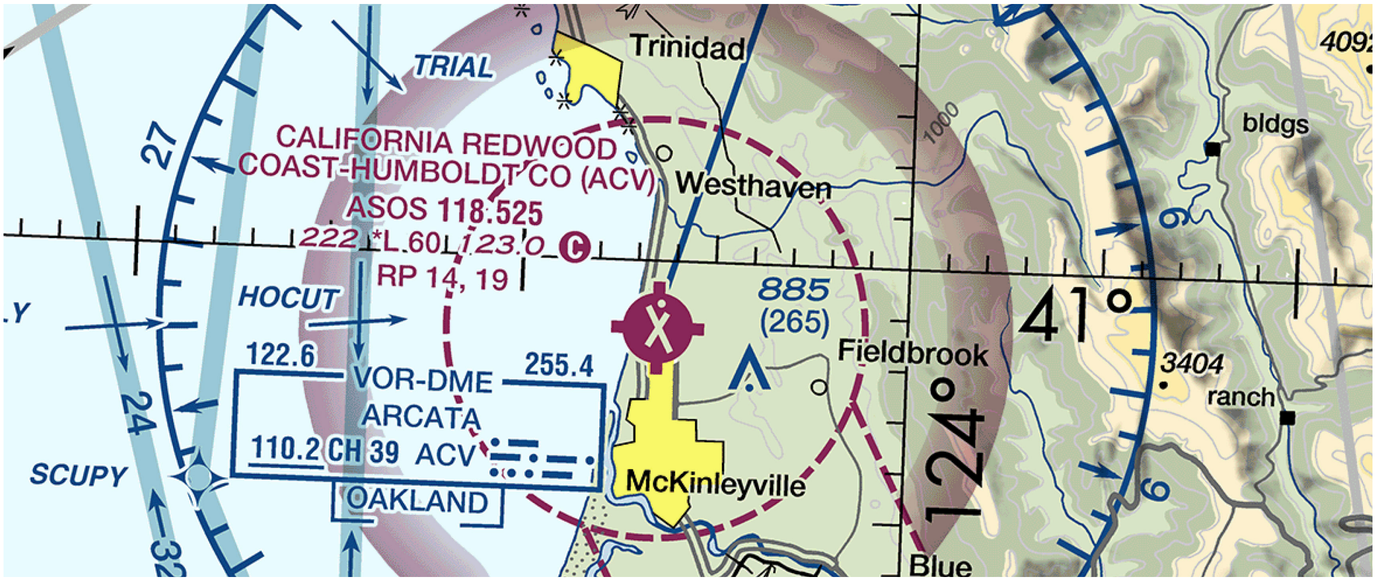


Figure 4–22: The symbol for California Redwood Coast-Humboldt CO (ACV) has tick marks on the top, bottom, and sides, which indicates that this airport sells fuel.

An airport symbol with a star at the top indicates that the airport has a rotating beacon. [**Figure 4–23**] There are several patterns emitted by rotating beacons that the FAA wants pilots to understand.

- A light that alternates between a **white flash** followed by a **green flash** indicates a **civilian** airport.
- **Dual-peaked white flashes** followed by a **green flash** indicates a **military** airport
- A light that alternates between a **white** flash followed by a **yellow** flash, then a **green** flash indicates a **heliport**.

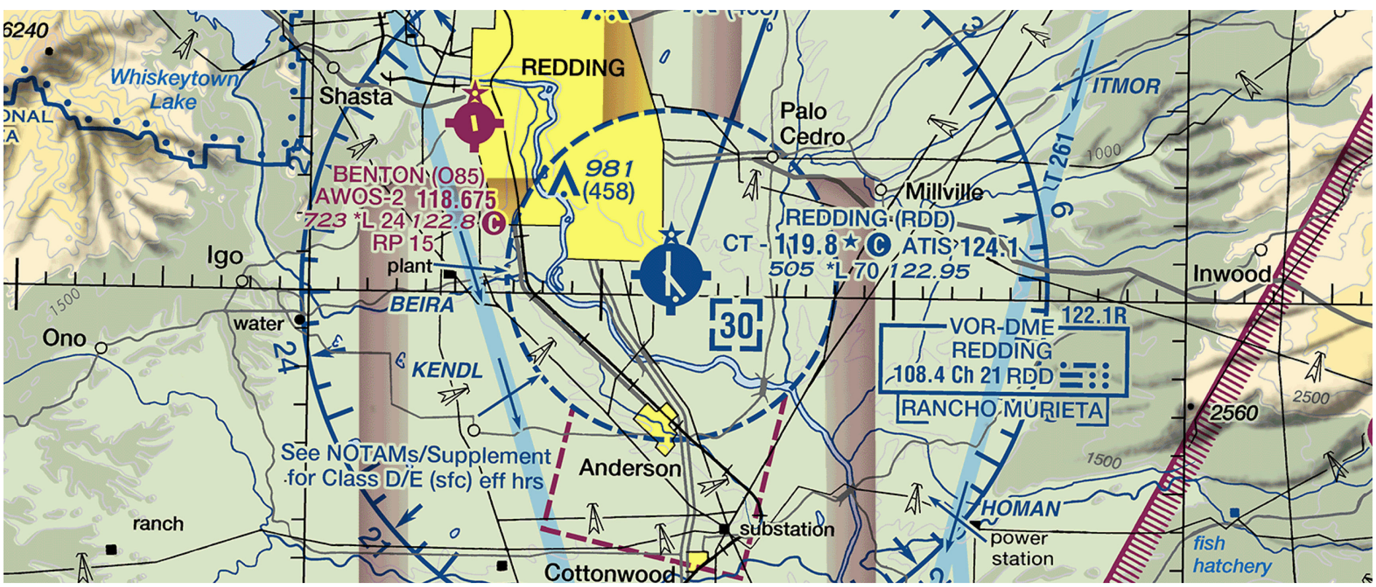


Figure 4–23: The symbol for Redding (RDD) has a star on the top, which indicates that this airport has a rotating beacon.

Radio Communication Procedures

Radio communications are an important aspect of the safe operation of aircraft in the NAS. It is through radio communications that pilots give and receive information before, during and at the conclusion of a flight. This information aids in the flow of aircraft in highly complex airspace areas as well as in less populated areas. Pilots can also send and receive important safety of flight issues such as unexpected weather conditions, and inflight emergencies. Although small UA pilots **are not** expected to communicate over radio frequencies, it is important for the UA pilot to understand "aviation language" and the different conversations they will encounter if the UA pilot is using a radio to aid them in situational awareness when operating in the NAS. Although much of the information provided here is geared toward manned aircraft pilots, the UA pilot needs to understand the unique way information is exchanged in the NAS.

Understanding Proper Radio Procedures

Understanding proper radio phraseology and procedures contribute to a pilot's ability to operate safely and efficiently in the airspace system. A review of the Pilot/Controller Glossary contained in the ***Aeronautical Information Manual (AIM)*** assists a pilot in understanding standard radio terminology. The AIM also contains many examples of radio communications. ICAO has adopted a phonetic alphabet that should be used in radio communications. When communicating with ATC, pilots should use this alphabet to identify their aircraft.[**Figure 4–24**]

Character	Morse Code	Telephony	Phonic Pronunciation	Character	Morse Code	Telephony	Phonic Pronunciation
A	*—	Alfa	(AL-FA)	S	***	Sierra	(SEE-AIR-RAH)
B	—***	Bravo	(BRAH-VOH)	T	—	Tango	(TANG-GO)
C	—*—*	Charlie	(CHAR-LEE) or (SHAR-LEE)	U	**—	Uniform	(YOU-NEE-FORM) or (OO-NEE-FORM)
D	—**	Delta	(DELL-TAH)	V	***—	Victor	(VIK-TAH)
E	*	Echo	(ECK-OH)	W	*— —	Whiskey	(WISS-KEY)
F	**—*	Foxtrot	(FOKS-TROT)	X	—**—	Xray	(ECKS-RAY)
G	— —*	Golf	(GOLF)	Y	—*— —	Yankee	(YANG-KEY)
H	****	Hotel	(HOH-TEL)	Z	— —**	Zulu	(ZOO-LOO)
I	**	India	(IN-DEE-AH)	1	*— — — —	One	(WUN)
J	* — — —	Juliett	(JEW-LEE-ETT)	2	**— — —	Two	(TOO)
K	—*—	Kilo	(KEY-LOH)	3	***— —	Three	(TREE)
L	*—**	Lima	(LEE-MAH)	4	****—	Four	(FOW-ER)
M	— —	Mike	(MIKE)	5	*****	Five	(FIFE)
N	—*	November	(NO-VEM-BER)	6	—****	Six	(SIX)
O	— — —	Oscar	(OSS-CAH)	7	— —***	Seven	(SEV-EN)
P	*— —*	Papa	(PAH-PAH)	8	— — —**	Eight	(AIT)
Q	— —*—	Quebec	(KEH-BECK)	9	— — — — *	Nine	(NIN-ER)
R	*—*	Romeo	(ROW-ME-OH)	0	— — — — —	Zero	(ZEE-RO)

Figure 4–24: Phonetic Alphabet.

Traffic Advisory Practices at Airports without Operating Control Towers

There is no substitute for alertness while in the vicinity of an airport. It is essential that pilots be alert and look for other traffic when operating at an airport without an operating control tower. This is of particular importance since other aircraft may not have communication capability or, in some cases, pilots may not communicate their presence or intentions when operating into or out of such airports. It is essential that all radio-equipped aircraft transmit/receive on a common frequency and small UA pilots **monitor** other aircraft identified for the purpose of airport advisories to achieve the greatest degree of safety

An airport may have a full or part-time tower or **flight service station (FSS)** located on the airport, a full or part-time **universal communications (UNICOM)** station or no aeronautical station at all. There are three ways for pilots to communicate their intention and obtain airport/traffic information when operating at an airport that does not have an operating tower—by communicating with an FSS, a UNICOM operator, or by making a **self-announced broadcast**.

Many airports are now providing completely automated weather, radio check capability, and airport advisory information on an automated UNICOM system. These systems offer a variety of features, typically selectable by microphone clicks, on the UNICOM frequency. Availability of the automated UNICOM will be published in the Airport/Facility Directory and approach charts.

Understanding Communication on a Common Frequency

The key to communications at an airport without an operating control tower is the selection of the correct common frequency. The acronym CTAF, which stands for Common Traffic Advisory Frequency, is synonymous with this program. A CTAF is a frequency designated for the purpose of carrying out airport advisory practices while operating to or from an airport without an operating control tower. The CTAF may be a UNICOM, MULTICOM, FSS, or tower frequency and is identified in appropriate aeronautical publications. On a sectional chart, the CTAF frequency is indicated by a shaded blue or magenta circle with the letter C inside. [**Figure 4–25**]

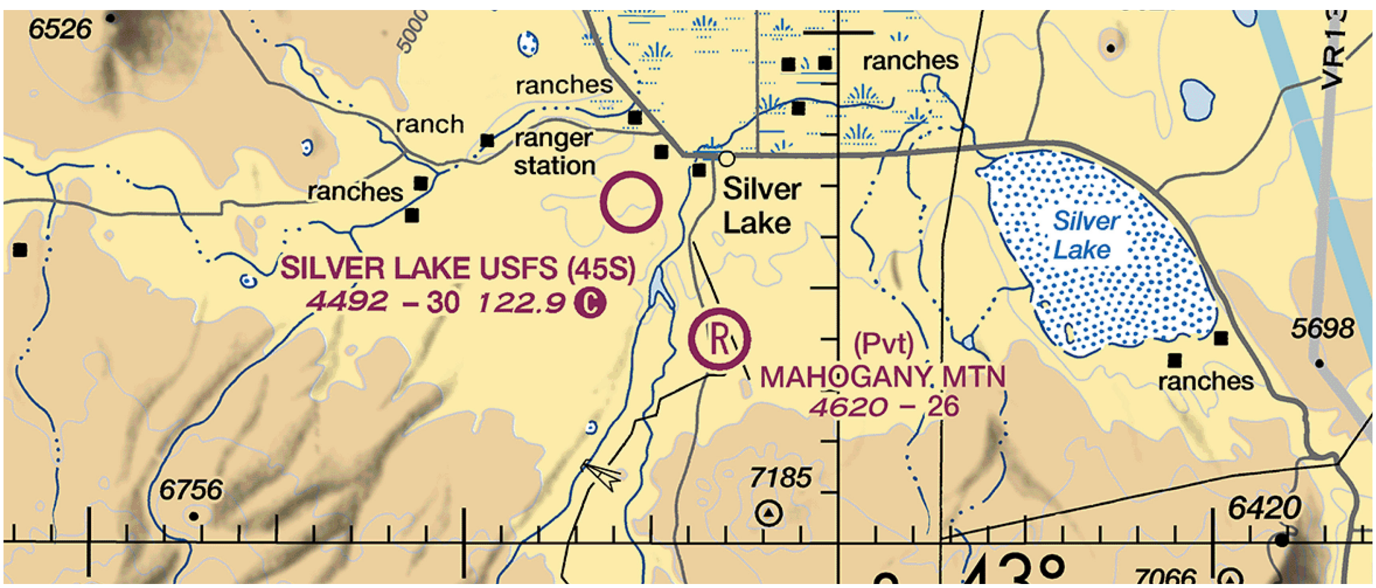


Figure 4–25: The CTAF radiofrequency for Silver Lake USFS (45S) is 122.9, indicated with a small solid-filled circle with the letter C inside.

Communication/Broadcast Procedures

A **MULTICOM** frequency of **122.9** will be used at an airport that is non-towered and does not have FSS or UNICOM.

Recommended Traffic Advisory Practices

Although a remote pilot-in-command is not required to communicate with manned aircraft when in the vicinity of a non-towered airport, safety in the National Airspace System requires that remote pilots are familiar with traffic patterns, radio procedures, and radio phraseology. When a remote pilot plans to operate close to a non-towered airport, the first step in radio procedures is to **identify the appropriate frequencies**. Most non-towered airports will have a UNICOM frequency, which is usually **122.8**; however, you should always check the Chart Supplements U.S. or sectional chart for the correct frequency. This frequency can vary when there are a large number of non-towered airports in the area. For non-towered airports that do not have a UNICOM or any other frequency listed, the MULTICOM frequency of **122.9** will be used. These frequencies can be found on a sectional chart by the airport or in the Chart Supplements publication from the FAA.

When a manned aircraft is inbound to a non-towered airport, the standard operating practice is for the pilot to "broadcast in the blind" when **10 miles from the airport**. This initial radio call will also include the position the aircraft is in relation to north, south, east, or west from the airport. For example:

Town and Country traffic, Cessna 123 Bravo Foxtrot is 10 miles south inbound for landing, Town, and Country traffic.

When a manned aircraft is broadcasting at a non-towed airport, the aircraft should use the name of the airport of intended landing at the beginning of the broadcast, and again at the end of the broadcast. The reason for stating the name twice is to allow others who are on the frequency to confirm where the aircraft is going. The next broadcast that the manned aircraft should make is:

Town and Country traffic, Cessna 123 Bravo Foxtrot, is entering the pattern, mid-field left down-wind for runway 18, Town and Country traffic.

The aircraft is now entering the traffic pattern. In this example, the aircraft is making a standard 45-degree entry to the downwind leg of the pattern for runway 18. Or, the aircraft could land straight- in without entering the typical rectangular traffic pattern. Usually, aircraft that are executing an instrument approach will use this method. Examples of a radio broadcast from aircraft that are using this technique are:

For an aircraft that is executing an instrument approach:

Town and Country traffic, Cessna 123 Bravo Foxtrot, is one mile north of the airport, GPS runway 18, full stop landing, Town and Country traffic.

As the aircraft flies the traffic pattern for a landing, the following radio broadcasts should be made:

Town and Country traffic, Cessna 123 Bravo Foxtrot, left base, runway 18, Town and Country traffic.

Town and Country traffic, Cessna 123 Bravo Foxtrot, final, runway 18, Town and Country traffic.

After the aircraft has landed and is clear of the runway, the following broadcast should be made:

Town and Country traffic, Cessna 123 Bravo Foxtrot, is clear of runway 18, taxing to park, Town and Country traffic.

When an aircraft is departing a non-towered airport, the same procedures apply. For example, when the aircraft is ready for takeoff, the aircraft should make the following broadcast:

Town and Country traffic, Cessna 123 Bravo Foxtrot, departing runway 18, Town and Country traffic.

When ATC requests the altitude of an aircraft, the altitude is always given in feet above mean sea level (MSL). For example, if a pilot wants to report that they are flying at 10,500 feet MSL, they might say:

Town and Country traffic, Cessna 123 Bravo Foxtrot one zero thousand five hundred, Town and Country traffic.

For safety reasons, a remote pilot must always scan the area where they are operating a small UA. This is especially important around an airport. While it is good operating procedures for manned aircraft to make radio broadcasts in the vicinity of a non-towered airport, by regulation, it is not mandatory. For this reason, a remote pilot must always look for other aircraft in the area and **use a radio for an extra layer of situational awareness**.

Aircraft Call Signs

When operating in the vicinity of any airport, either towered or non-towered, it is important for a remote pilot to understand radio communications of manned aircraft in the area. Although 14 CFR part 107 only requires the remote pilot to receive authorization to operate in certain airport areas, it can be a good operating practice to have a radio that will allow the remote pilot to monitor the appropriate frequencies in the area. The remote pilot should **refrain from transmitting** over any active aviation frequency unless there is an emergency situation.

Aviation has unique communication procedures that will be foreign to a remote pilot who has not been exposed to “aviation language” previously. One of those is aircraft call signs. All aircraft that are registered in the United States will have a unique registration number, or “N” number. For example, N123AB, which would be pronounced in aviation terms by use of the phonetic alphabet as “November One-Two-Three-Alpha-Bravo.” In most cases, “November” will be replaced with either the aircraft manufacturer’s name (make) and in some cases, the type of aircraft (model). Usually, when the aircraft is a light general aviation (GA) aircraft, the manufacturer’s name will be used. In this case, if N123AB is a Cessna 172, the call sign would be “Cessna, One-Two-Three-Alpha-Bravo.” If the aircraft is a heavier GA aircraft, such as a turbo-prop, or turbo-jet, the aircraft’s model will be used in the call sign. If N123AB is a Cessna Citation, the call sign would be stated as, “Citation, One-Two-Three-Alpha-Bravo.” Typically, airliners will use the name of their companies and their flight number in their call signs. For example, Southwest Airlines flight 711 would be said as “Southwest- Seven-One-One.” There are a few airlines such as British Airways who will not use the company name in their call sign. For example, British Airways uses “Speedbird.”

A remote pilot is **not expected to communicate with other aircraft** in the vicinity of an airport, and **should not do so** unless there is an **emergency situation**. However, in the interest of safety in the NAS, it is important that a remote pilot understands the aviation language and the types of aircraft that can be operating in the same area as a small UA.

Automatic Terminal Information Service (ATIS)

Automatic Terminal Information Service (ATIS) is a continuous broadcast of recorded non-control information in selected high-activity terminals. Airports with a high traffic volume use ATIS to provide this information without having to communicate individually to each pilot. To keep the message short, ATIS will *not* provide the sky condition and visibility when the ceiling is at least **5,000 feet,** and visibility is **5 miles** or more. On a sectional chart, the ATIS frequency is located after the CTAF frequency. [**Figure 4–26**]

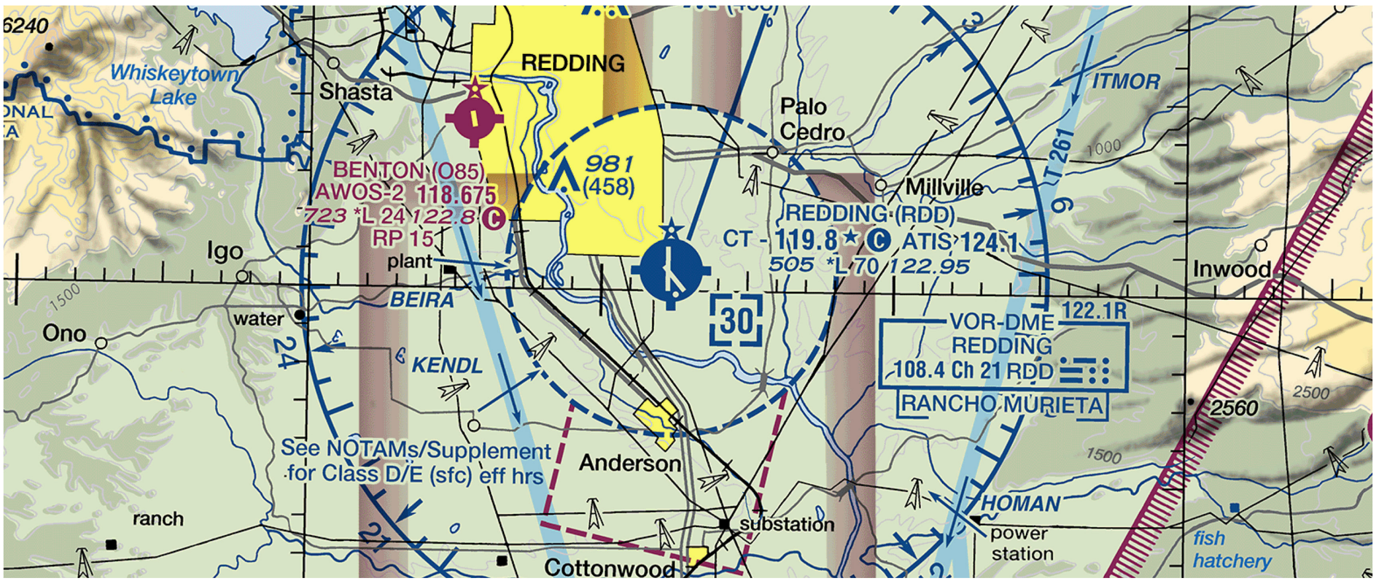


Figure 4–26: The ATIS frequency for Redding (RDD) is 124.1

Communication Procedures for Class D Airspace

Two-way communication with ATC must be established to enter Class D airspace. However, no clearance is required to enter Class D airspace after two-way communication is established. Class D airspace only exists when the control tower is in operation. When the control tower **is not in operation**, it reverts to either **Class E** airspace or a combination of **Class E and Class G** airspace. Pilots should refer to the Chart Supplement for information about a specific airport.[**Figure 4–27**].

SIOUX CITY TOWER 118.7 (1200–0330Z‡) **GND CON** 121.9
AIRSPACE: CLASS D svc 1200–0330Z‡ other times CLASS E.
RADIO AIDS TO NAVIGATION: NOTAM FILE SUX.

Figure 4–27: The Chart Supplement indicates that this Class D airspace reverts to Class E airspace when the control tower is not operational.

Communication Procedures for Class C Airspace

To enter Class C airspace, establishing two-way communication with ATC is required. However, no clearance is required to enter Class C airspace after two-way communication is established. Class C airspace provides the sequencing of all aircraft and separation services from all IFR aircraft.

Communication Procedures for Class B Airspace

Pilots must have clearance from ATC to enter Class B airspace. Class B airspace provides both sequencing and separation from all aircraft.

Locating Traffic Using a Clock

ATC provides the location of other traffic information to pilots using the position on a clock relative to the pilot's path of flight. The path of flight is given in reference to the aircraft's **ground track**. [**Figure 4–28**]

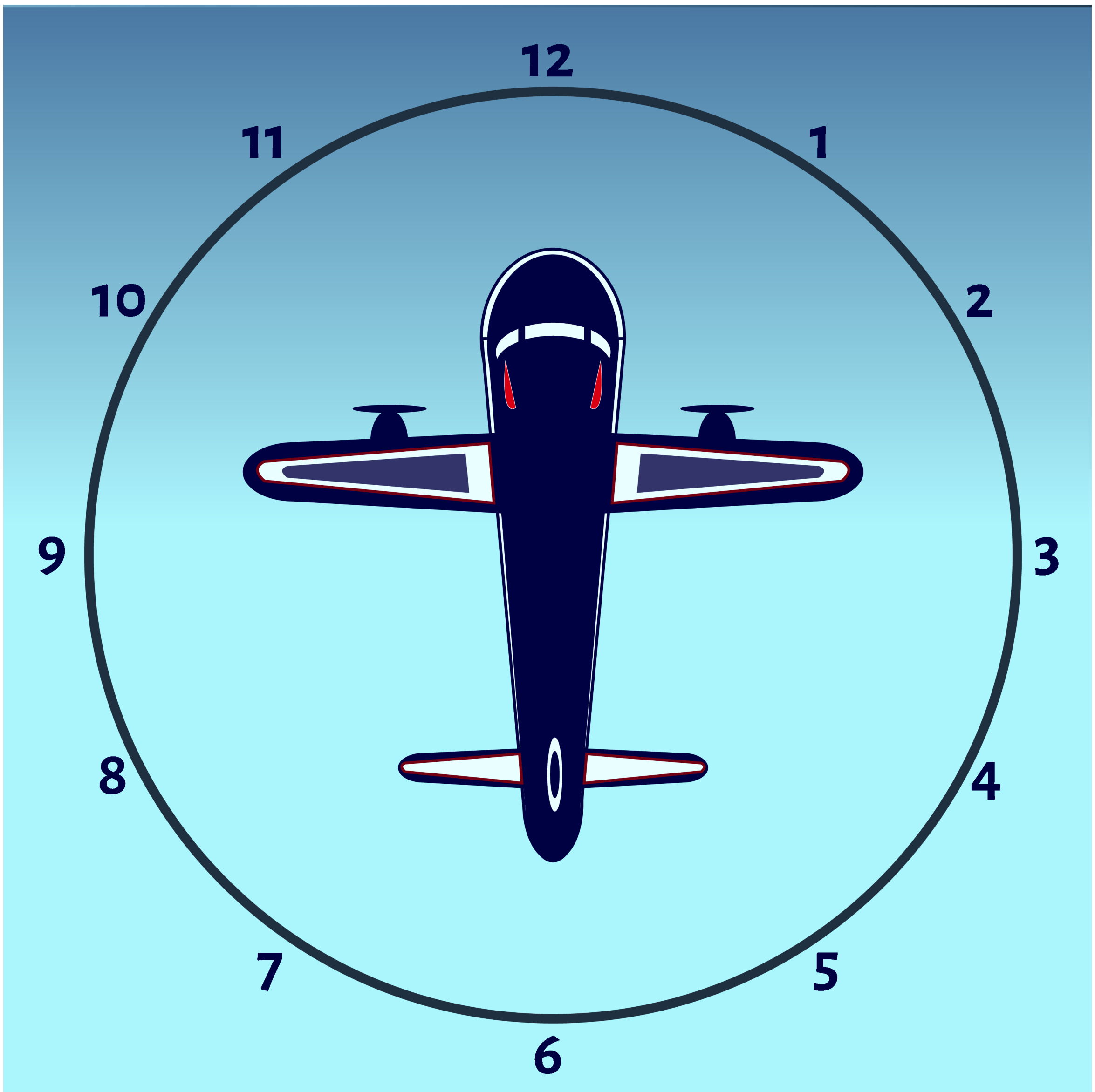


Figure 4–28: If ATC communicated that traffic was at one o'clock five miles westbound, it would be that another aircraft was directly ahead and to the right.

Aviation Time

For clarity, all flight plans and weather reports are filed in **Coordinated Universal Time (UTC)**, often referred to as "Zulu" time. Zulu time is based on the time in Greenwich, England. Additionally, in aviation, pilots use a 24-hour clock. On the lower left of **Figure 4–29** there is a table for converting between UTC and other times zones in the United States. On the Aeronautical Knowledge Exam, the FAA may ask test-takers convert between UTC and various times zones.

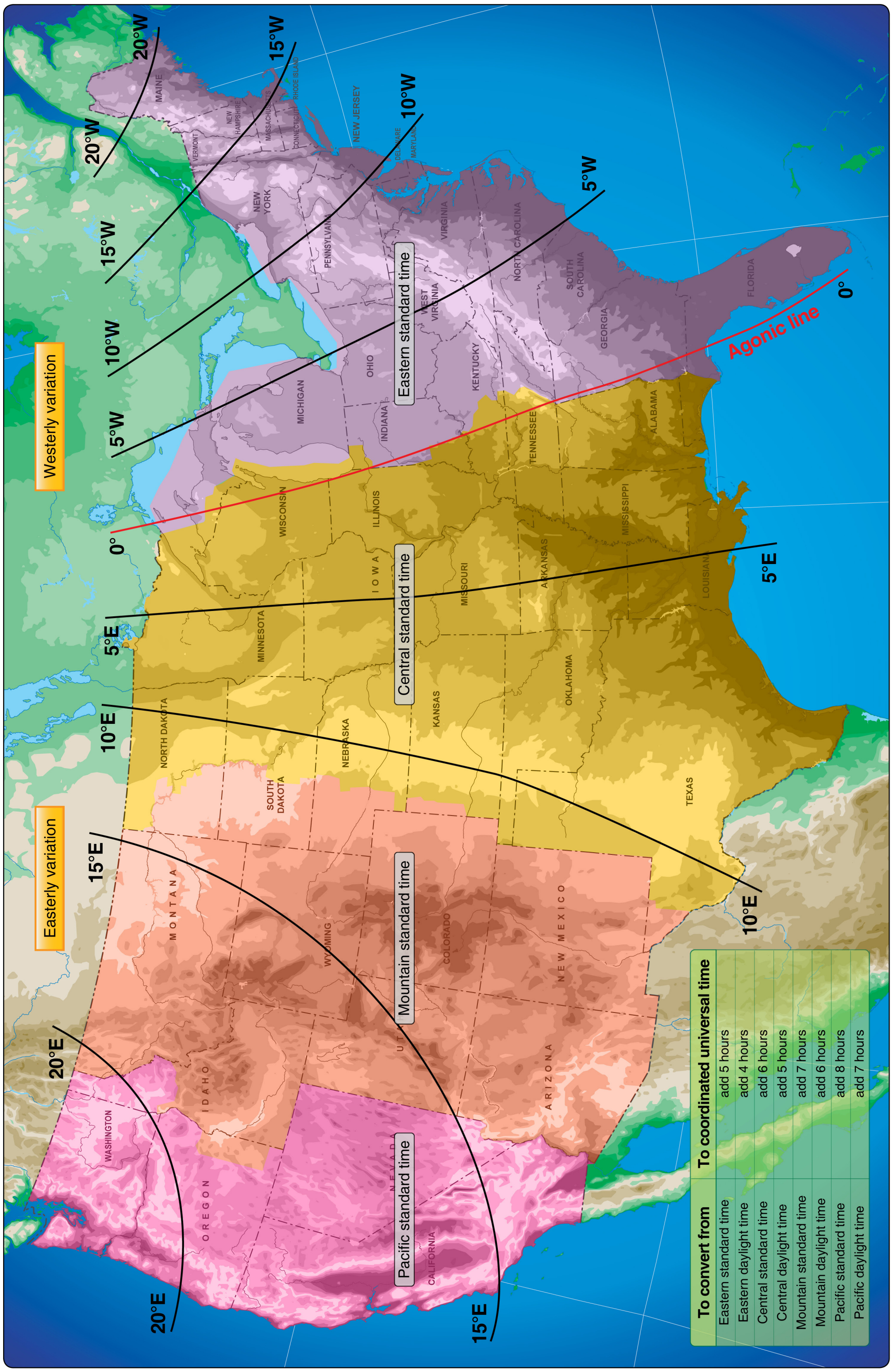


Figure 4–29: Time conversion table.

Sample Questions

Readers may locate the answers to the following questions in Appendix A. The sample questions in this book sometimes refer to figures from the ***FAA-CT-8080-2H Airman Knowledge Testing Supplement***. [1]

4001. The most comprehensive information on a given airport is provided by

A. the Chart Supplements U.S. (formerly Airport Facility Directory).

B. Notices to Airmen (NOTAMS).

C. Terminal Area Chart (TAC).

4002. (**Refer to Figure 50**.) The segmented circle indicates that a landing on Runway 27 will be with a

A. right-quartering headwind.

B. left-quartering headwind.

C. right-quartering tailwind.

4003. (**Refer to Figure 25**, area 3.) If Dallas Executive (RDB) Tower is not in operation, which frequency should be used as a Common Traffic Advisory Frequency (CTAF) to monitor airport traffic?

A. 127.25 MHz.

B. 122.95 MHz.

C. 126.35 MHz.

4004. (**Refer to Figure 22**, area 2.) At Coeur D'Alene, which frequency should be used as a Common Traffic Advisory Frequency (CTAF) to monitor airport traffic?

A. 122.05 MHz.

B. 135.075 MHz.

C. 122.8 MHz.

4005. Automatic Terminal Information Service (ATIS) is the continuous broadcast of recorded information concerning

A. pilots of radar-identified aircraft whose aircraft is in dangerous proximity to terrain or to an obstruction.

B. nonessential information to reduce frequency congestion.

C. noncontrol information in selected high activity terminal areas.

4006. (**Refer to Figure 52**.) Traffic patterns in effect at Lincoln Municipal are

A. to the right on Runway 17 and Runway 35; to the left on Runway 18 and Runway 35.

B. to the left on Runway 17 and Runway 36; to the right on Runway 18 and Runway 35.

C. to the right on Runways 14 - 32.

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1 URL: https://www.amazon.com/FAA-CT-8080-2H-Knowledge-Testing-Supplement-Recreational/dp/1674175949/

4007. An ATC radar facility issues the following advisory to a pilot flying on a heading of 090°:

"TRAFFIC 3 O'CLOCK, 2 MILES, WESTBOUND..."

Where should the pilot look for this traffic?

A. East.

B. South.

C. West.

4008. When an air traffic controller issues radar traffic information in relation to the 12-hour clock, the reference the controller uses is the aircraft's

A. true course.

B. ground track.

C. magnetic heading.

4009. (**Refer to Figure 48**.) What is the difference between area A and area E on the airport depicted?

A. "A" may be used for taxi and takeoff; "E" may be used only as an overrun.

B. "A" may be used for all operations except heavy aircraft landings; "E" may be used only as an overrun.

C. "A" may be used only for taxiing; "E" may be used for all operations except landings.

4010. An ATC radar facility issues the following advisory to a pilot flying on a heading of 360°:

"TRAFFIC 10 O'CLOCK, 2 MILES, SOUTHBOUND..."

Where should the pilot look for this traffic?

A. Northwest.

B. Northeast.

C. Southwest.

4011. The numbers 8 and 26 on the approach ends of the runway indicate that the runway is orientated approximately

A. 008° and 026° true.

B. 080° and 260° true.

C. 080° and 260° magnetic.

4012. What does the outbound destination sign identify?

A. Identifies entrance to the runway from a taxiway.

B. Identifies the runway on which an aircraft is located.

C. Identifies direction to take-off runways.

4013. “Runway hold position” markings on the taxiway

A. identifies where aircraft hold short of the runway.

B. identifies an area where aircraft are prohibited.

C. allows aircraft permission onto the runway.

4014. When a control tower, located on an airport within Class D airspace, ceases operation for the day, what happens to the airspace designation?

A. The airspace designation normally will not change.

B. The airspace remains Class D airspace as long as a weather observer or automated weather system is available.

C. The airspace reverts to Class E or a combination of Class E and G airspace during the hours the tower is not in operation.

4015. A military air station can be identified by a rotating beacon that emits

A. white and green alternating flashes.

B. two quick, white flashes between green flashes.

C. green, yellow, and white flashes.

4016. (**Refer to Figure 50**.) The segmented circle indicates that the airport traffic is

A. left-hand for Runway 36 and right-hand for Runway 18.

B. left-hand for Runway 18 and right-hand for Runway 36.

C. right-hand for Runway 9 and left-hand for Runway 27.

4017. (**Refer to Figure 27**.) An aircraft departs an airport in the central standard time zone at 0930 CST for a 2-hour flight to an airport located in the mountain standard time zone. The landing should be at what time?

A. 0930 MST.

B. 1030 MST.

C. 1130 MST.

4018. When flying HAWK N666CB, the proper phraseology for initial contact with McAlester AFSS is

A. “MC ALESTER RADIO, HAWK SIX SIX SIX CHARLIE BRAVO, RECEIVING ARDMORE VORTAC, OVER.”

B. “MC ALESTER STATION, HAWK SIX SIX SIX CEE BEE, RECEIVING ARDMORE VORTAC, OVER.”

C. “MC ALESTER FLIGHT SERVICE STATION, HAWK NOVEMBER SIX CHARLIE BRAVO, RECEIVING ARDMORE VORTAC, OVER.”

4019. The “yellow demarcation bar” marking indicates

A. runway with a displaced threshold that precedes the runway.

B. a hold line from a taxiway to a runway.

C. the beginning of the available runway for landing on the approach side.

4020. An ATC radar facility issues the following advisory to a pilot flying north in a calm wind:

"TRAFFIC 9 O'CLOCK, 2 MILES, SOUTHBOUND..."

Where should the pilot look for this traffic?

A. South.

B. North.

C. West.

4021. (**Refer to Figure 26**, area 5.) What is the CTAF/UNICOM frequency at Barnes County Airport?

A. 122.0 MHz.

B. 122.8 MHz.

C. 123.6 MHz.

4022. As a standard operating practice, all inbound traffic to an airport without a control tower should continuously monitor the appropriate facility from a distance of

A. 25 miles.

B. 20 miles.

C. 10 miles.

4023. An ATC radar facility issues the following advisory to a pilot during a local flight:

"TRAFFIC 2 O'CLOCK, 5 MILES, NORTHBOUND..."

Where should the pilot look for this traffic?

A. Between directly ahead and 90° to the left.

B. Between directly behind and 90° to the right.

C. Between directly ahead and 90° to the right.

4024. (**Refer to Figure 64**.) Which marking indicates a vehicle lane?

A. A.

B. C.

C. E.

4025. The "runway hold position" sign denotes

A. intersecting runways.

B. an entrance to runway from a taxiway.

C. an area protected for an aircraft approaching a runway.

4026. Airspace at an airport with a part-time control tower is classified as Class D airspace only

A. when the weather minimums are below basic VFR.

B. when the associated control tower is in operation.

C. when the associated Flight Service Station is in operation.

4027. You are conducting sUAS operations just north of an airport when ATC instructs you to remain clear of final for runway 9. You

A. must cease your operations.

B. can continue your operations.

C. must keep your sUAS below 100 feet AGL.

4028. (**Refer to Figure 65**.) The red symbol at sign D would most likely be found

A. upon exiting all runways prior to calling ground control.

B. near the approach end of ILS runways.

C. at an intersection where a roadway may be mistaken as a taxiway.

4029. When approaching taxiway holding lines from the side with the continuous lines, the pilot

A. may continue taxiing.

B. should not cross the lines without ATC clearance.

C. should continue taxiing until all parts of the aircraft have crossed the lines.

4030. (**Refer to Figure 48**.) Area C on the airport depicted is classified as a

A. stabilized area.

B. heliport.

C. closed runway.

4031. (**Refer to Figure 21**, area 2.) The CTAF/MULTICOM frequency for Garrison Airport is

A. 122.8 MHz.

B. 122.9 MHz.

C. 123.0 MHz.

4032. The numbers 9 and 27 on a runway indicate that the runway is oriented approximately

A. 009° and 027° true.

B. 090° and 270° true.

C. 090° and 270° magnetic.

4033. (**Refer to Figure 48**.) According to the airport diagram, which statement is true?

A. Runway 30 is equipped at position E with emergency arresting gear to provide a means of stopping military aircraft.

B. Takeoffs may be started at position A on Runway 12, and the landing portion of this runway begins at position B.

C. The takeoff and landing portion of Runway 12 begins at position B.

4034. The "taxiway ending" marker

A. indicates the taxiway does not continue.

B. identifies an area where aircraft are prohibited.

C. provides general taxiing direction to the named taxiway.

Chapter 5: Weather

Before flight operations, remote pilots should consider factors such as wind, temperature, air pressure, atmospheric stability, uneven surface heating, visibility, and cloud clearance.

Standard Atmosphere

Understanding the concepts related to the standard atmosphere is important for determining the effects of atmospheric conditions on aircraft performance. A **standard atmosphere** has a standard temperature and standard pressure. The **standard temperature** at sea level is **15°C** (**59°F**). The **standard pressure** at sea level is **1013.2 millibars** (**29.92 inches**) of mercury. Remote pilots should memorize these numbers for the Aeronautical Knowledge Exam.

High and Low-Pressure Systems

Every physical process of weather is the result of heat exchange between water, air, and land. Variations in altimeter settings between weather reporting stations are caused by unequal heating of the Earth's surface, causing pressure differences. Between high-pressure systems and low-pressure systems, the wind will always try to move from areas of high pressure to low pressure. Winds on the surface of the earth move in a relatively straight line due to the friction caused by Earth's surface. Winds aloft do not move in a straight line. Instead, they rotate around the regions of high and low pressure. Winds rotate clockwise around the center of a high-pressure system. As the winds aloft travel to areas of low pressure, they move counter-clockwise. [**Figure 5–1**]

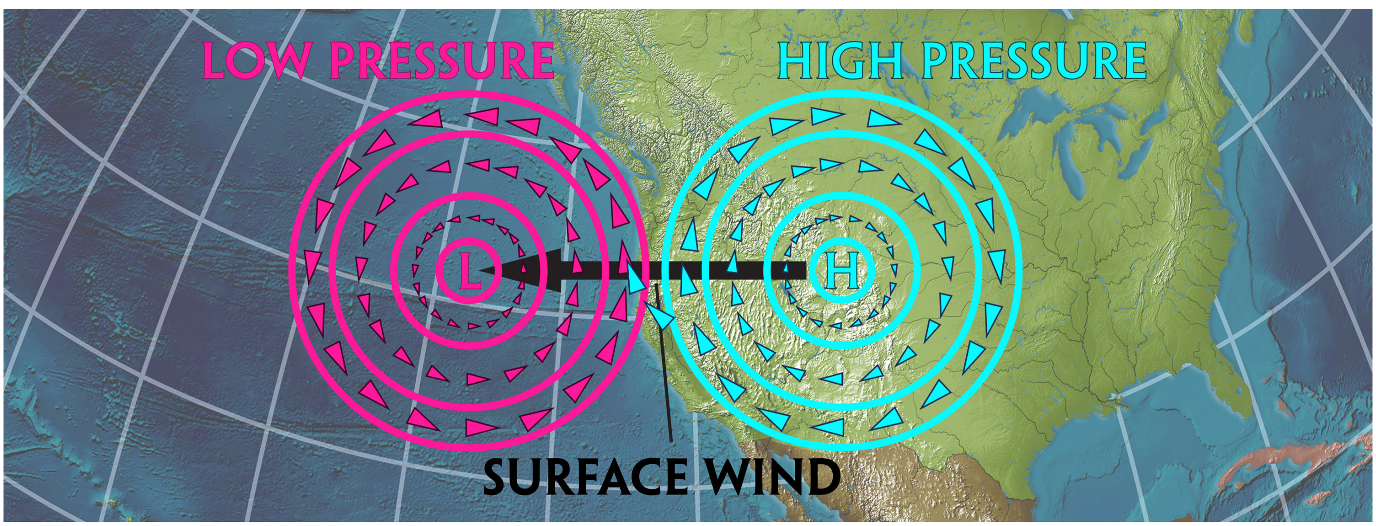

Figure 5–1: Winds on the surface of the earth moves in a relatively straight line between high to low pressure due to the friction caused by Earth's surface.

Fronts

As air masses move out of their source regions, they come in contact with other air masses of different properties. The zone between two different air masses is a frontal zone or **front**. Across this zone, temperature, humidity, and wind often change rapidly over short distances. The symbols for a cold front include a triangle pointing toward the direction of movement. The symbols for a warm front include half circles pointing toward the direction of movement.[**Figure 5–2**]

Figure 5–2: When moving across a frontal zone, there will always be a change in wind direction and temperature.

Temperature/Dew Point Relationship

The amount of water vapor that the air can hold in suspension depends on air temperature. The colder air holds less moisture than warmer air. There are several processes in which water transforms between gaseous, liquid, and solid states. **Evaporation** is the process where water moves from a liquid state to a gaseous (vapor) state. **Condensation** is the process where water moves from a gaseous state to a liquid. **Deposition** is the process where water moves from a gaseous state to a solid (frozen) state. **Sublimation** is the process where water moves from a solid-state to a gaseous state. The two processes by which moisture is added to unsaturated air is **evaporation** and **sublimation**.

The relationship between dew point and temperature defines the concept of relative humidity. The **dew point**, given in degrees, is the temperature at which the air can hold **no more moisture**. When the temperature of the air is reduced to the dew point, the air is completely saturated, and moisture begins to condense out of the air in the form of fog, dew, frost, clouds, rain, or snow.

Methods by Which Air Reaches the Saturation Point

If air reaches the saturation point while temperature and dew point are **close together**, it is highly likely that fog, low clouds, and precipitation will form. There are four methods by which air can reach the saturation point. First, when warm air moves over a cold surface, the air temperature drops and reaches the saturation point. Second, the saturation point may be reached when cold air and warm air mix. Third, when the air cools at night through contact with the cooler ground, air reaches its saturation point. The fourth method occurs when air is lifted or is forced upward in the atmosphere.

Calculating the Height of the Clouds

Using the temperature, the dew point, and the spread between one may estimate the altitude of the base of a cumulus cloud. The temperature and the dew point get closer together with altitude. The rate at which they get closer together is **4.4° F per thousand feet**. For example, what is the height above the ground level of a cumulous cloud if the surface air temperature is 82°F, and the dew point is 38°F? [**Figure 5–3**]

Start by subtracting the difference between the temperature and the dew point. **82° - 38° = 44°.**

Divide the difference by 4.4°. **44° ÷ 4.4° = 10**.

Multiply the result by 1,000 to get the height of the base of the cloud. **10 x 1,000 = 10,000 ft AGL.**

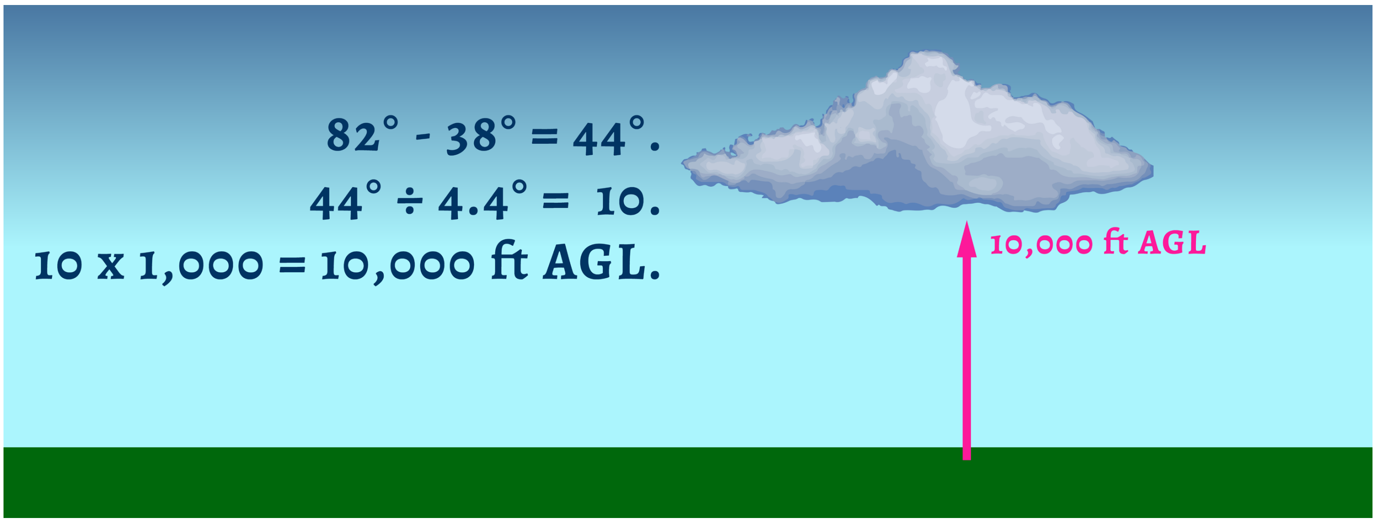

Figure 5–3: The height of the base of a cloud can be determined using the temperature and the dew point.

Dew and Frost

On cool, clear, calm nights, the temperature of the ground and objects on the surface can cause temperatures of the surrounding air to drop below the dew point. When this occurs, the moisture in the air condenses and deposits itself on the ground, buildings, and other objects like cars and aircraft. This moisture is known as **dew** and sometimes can be seen on the grass and other objects in the morning.

Structural Icing

If the temperature of a collecting surface, such as the wing on an aircraft, is at or below the dewpoint, and the dewpoint is below freezing, then the moisture is deposited in the form of **frost** or structural ice. For frost or structural icing to form on an aircraft, visible moisture must be present, such as clouds, snow, or freezing rain. **Freezing rain** occurs when a warm front moves over a cold front. As rain falls from the warmer air into the colder air mass, it begins to freeze. Eventually, the rain becomes ice pellets. The highest accumulation rate of structural ice occurs during freezing rain.

Two conditions are necessary for structural icing in flight:

1. The aircraft must be flying through visible water such as rain or cloud droplets
2. The temperature at the point where the moisture strikes the aircraft must be 0° C or colder.

Aerodynamic cooling can lower the temperature of an airfoil to 0° C even though the ambient temperature is a few degrees warmer. While dew poses no threat to a small UA, frost poses a definite flight safety hazard. Frost disrupts the flow of air over the wing and can drastically reduce the production of lift. It also increases drag, which, when combined with lowered

lift production, can adversely affect the ability to take off. A small UA must be thoroughly cleaned and free of frost prior to beginning a flight.

Atmospheric Stability

The stability of the atmosphere depends on its ability to resist vertical motion. A stable atmosphere makes vertical movement difficult, and small vertical disturbances dampen out and disappear. In an unstable atmosphere, small vertical air movements tend to become larger, resulting in turbulent airflow and convective activity. Instability can lead to significant turbulence, extensive vertical clouds, and severe weather.

The combination of moisture and temperature determine the stability of the air and the resulting weather. Cool, dry air is very stable and resists vertical movement, which leads to good and generally clear weather. The greatest instability occurs when the air is moist and warm, as it is in the tropical regions in the summer. Typically, thunderstorms appear on a daily basis in these regions due to the instability of the surrounding air.

The stability of an air mass determines its typical weather characteristics. When one type of air mass overlies another, conditions change with height. Characteristics typical of an unstable and stable air mass are as follows:

Unstable Air	Stable Air
Cumuliform clouds	Stratiform clouds and fog
Showery precipitation	Continuous precipitation
Rough air (turbulence)	Smooth air
Good visibility (except in blowing obstructions)	Fair to poor visibility in haze and smoke

Temperature Inversion

As air rises and expands in the atmosphere, the temperature **decreases**. However, there is an atmospheric anomaly that can occur that changes this typical pattern of atmospheric behavior. When the temperature of the air **rises** with altitude, a **temperature inversion** exists.[**Figure 5–4**] Inversion layers are commonly shallow layers of **smooth, stable air** close to the ground. The temperature of the air increases with altitude to a certain point, which is the top of the inversion. The air at the top of the layer acts as a lid, keeping weather and pollutants trapped below. If the relative humidity of the air is high, it can contribute to the formation of clouds, fog, haze, or smoke resulting in **diminished visibility** in the inversion layer. **Frontal inversions** occur when warm air spreads over a layer of cooler air, or cooler air is forced under a layer of warmer air.

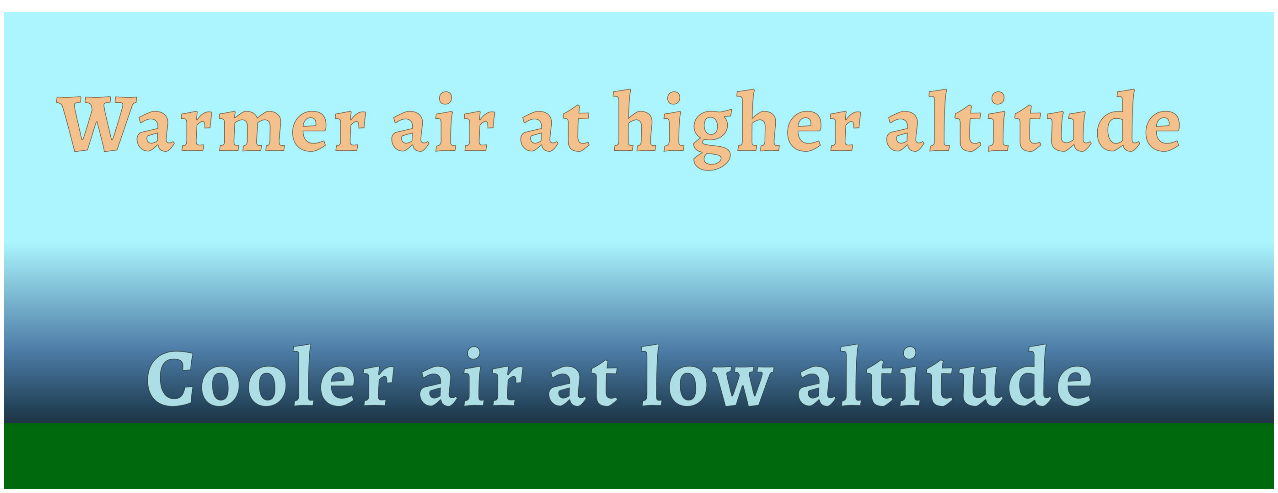

Figure 5–4: Temperature inversion.

Low-Level Wind Shear

Low-level wind shear is commonly associated with passing frontal systems, thunderstorms, temperature inversions, and strong upper-level winds (windspeed at **2,000 to 4,000 feet AGL** is at least **25 knots**). **Wind shear** is a sudden, drastic change in wind speed and/or direction over a very small area. Wind shear can subject an aircraft to violent updrafts and downdrafts, as well as abrupt changes to the horizontal movement of the aircraft. While wind shear can occur **at any altitude**, low-level wind shear is especially hazardous due to the proximity of an aircraft to the ground.

Wind shear is dangerous to an aircraft. It can rapidly change the performance of the aircraft and disrupt the normal flight attitude. For example, a tailwind quickly changing to a headwind causes an increase in airspeed and performance. Conversely, a headwind changing to a tailwind causes a decrease in airspeed and performance. In either case, a pilot must be prepared to react immediately to these changes to maintain control of the aircraft.

The most severe type of low-level wind shear, a **microburst**, is associated with convective precipitation into dry air at cloud base. Microburst activity may be indicated by an intense rain shaft at the surface, but virga at cloud base and a ring of blowing dust is often the only visible clue. A typical microburst has a horizontal diameter of 1–2 miles and a nominal depth of 1,000 feet. The lifespan of a microburst is about 5–15 minutes, during which time it can produce downdrafts of up to 6,000 feet per minute (fpm) and headwind losses of 30–90 knots, seriously degrading performance. It can also produce strong turbulence and hazardous wind direction changes. During an inadvertent microburst encounter, the small UA may first experience a performance-increasing headwind, followed by the performance- decreasing downdrafts, followed by a rapidly increasing tailwind. This can result in terrain impact or flight dangerously close to the ground. An encounter during approach involves the same sequence of wind changes and could force the small UA to the ground short of the intended landing area.

It is important to remember that wind shear can affect any flight at any altitude. While wind shear may be reported, it often remains undetected and is a silent danger to aviation. Always be alert to the possibility of wind shear, especially when flying in and around thunderstorms and frontal systems.

Fog

Surface-based temperature inversions occur on **clear, cool nights** where the heat radiates off into space. This phenomenon is known as **terrestrial radiation**. When the air close to the ground is cooled by the lowering temperature of the ground. The air within a few hundred feet of the surface becomes cooler than the air above it, forming radiation fog. **Radiation fog** (ground fog) is most likely to develop in warm, moist air over low flatland areas on clear calm nights. [**Figure 5–5**]

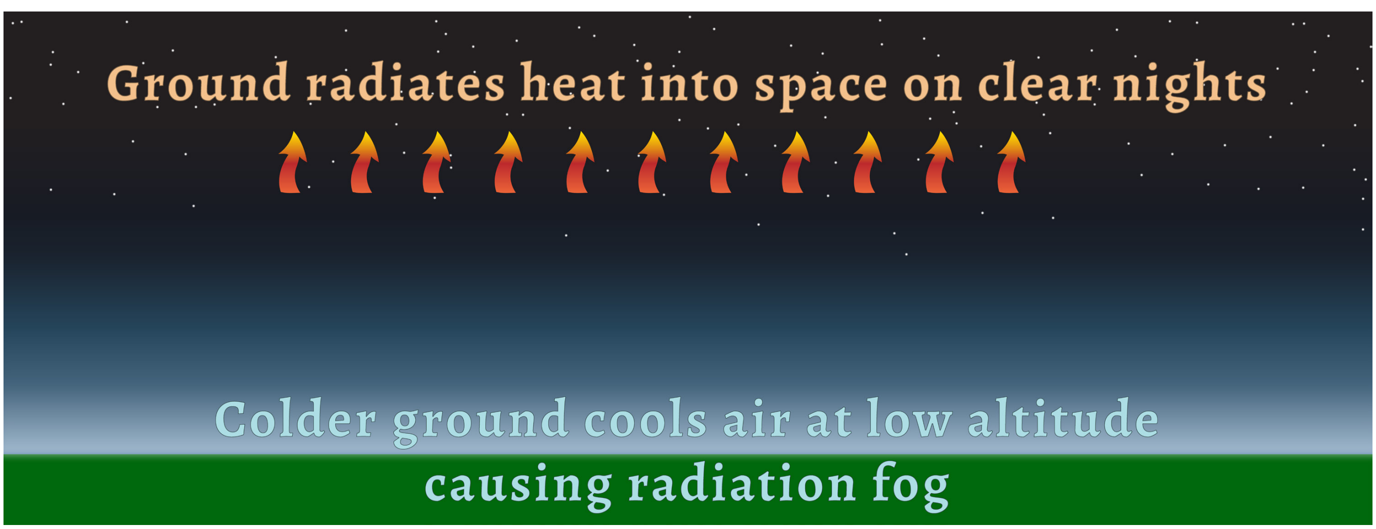

Figure 5–5: Radiation fog forms in warm, moist air over low flatland areas on clear, calm nights.

Advection fog forms when an air mass moves inland from the coast in winter. Warmer air from the ocean moves inland and cools down, condensing the moisture and forming fog. [**Figure 5–6**]

Figure 5–6: Advection fog occurs when the wind blows warmer air inland during winter.

When the wind blows air upslope, it cools down and forms **upslope fog**. [**Figure 5–7**]

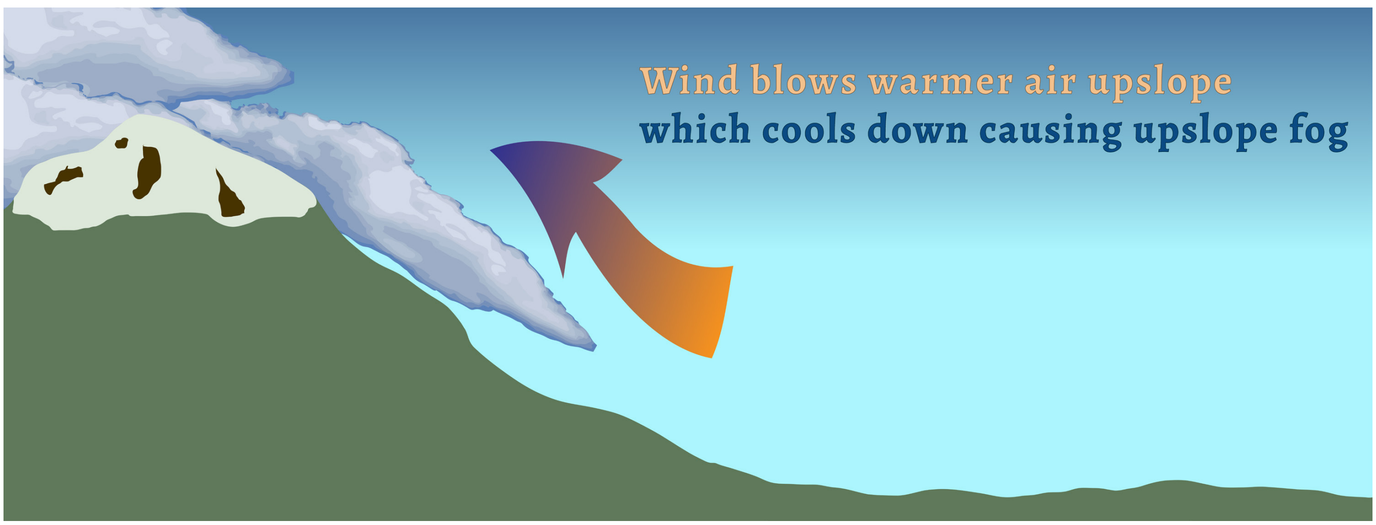

Figure 5–7: Both advection fog and upslope fog rely on wind to form.

Steam fog forms in very cold areas, such as the polar regions of Earth. Cold air from land moves over the relatively warmer ocean, which causes steam fog. [**Figure 5–8**]`

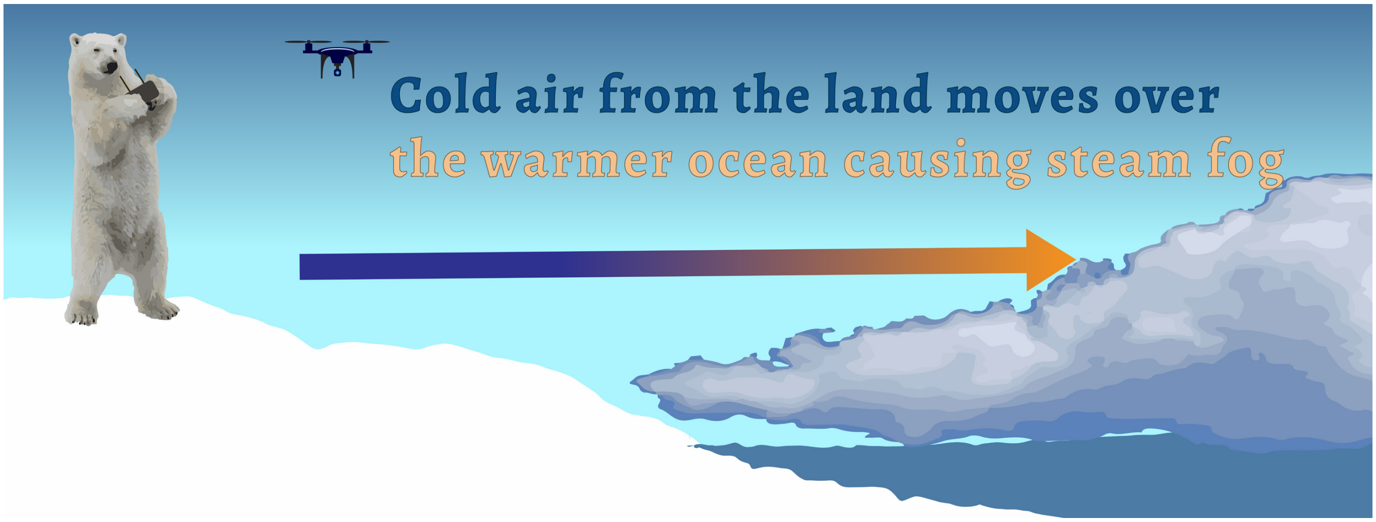

Figure 5–8: Steam fog can be dangerous because it causes low-level turbulence and icing.

Clouds

Clouds are divided into four families based on their **height range**, low, middle, and high altitude clouds. Additionally, there are also towering clouds with a high degree of vertical development. To pilots, the cumulonimbus cloud is perhaps the most dangerous cloud type. The suffix "nimbus" indicates a rain cloud. It appears individually or in groups and is known as either an air mass or an orographic thunderstorm. Heating of the air near the Earth's surface creates an air mass thunderstorm; the upslope motion of air in the mountainous regions causes orographic thunderstorms. Cumulonimbus clouds that form in a continuous line are non-frontal bands of thunderstorms or **squall lines**.

Since rising air currents cause cumulonimbus clouds, they are extremely turbulent and pose a significant hazard to flight safety. For example, if a small UA enters a thunderstorm, the small UA could experience updrafts and downdrafts that exceed 3,000 fpm. In addition, thunderstorms can produce large hailstones, damaging lightning, tornadoes, and large quantities of water, all of which are potentially hazardous to an aircraft.

Thunderstorm Life Cycle

A thunderstorm cell during its life cycle progresses through three stages-(1) the cumulus, (2) the mature, and (3) the dissipating.[**Figure 5–9**] It is virtually impossible to detect the transition from one stage to another visually; the transition is subtle and by no means abrupt. Furthermore, a thunderstorm may be a cluster of cells in different stages of the lifecycle.

The Cumulus Stage

Although most cumulus clouds do not grow into thunderstorms, every thunderstorm begins as a cumulus. The key feature of the cumulus stage is an **updraft,** as illustrated in **Figure 5–9**. The updraft varies in strength and extends from very near the surface to the cloud top. The growth rate of the cloud may exceed 3,000 feet per minute, so it is inadvisable to operate a small UA in an area of rapidly building cumulus clouds. Early during the cumulus stage, water droplets are quite small but grow to raindrop size as the cloud grows. The upwelling air carries the liquid water above the freezing level creating an icing hazard. As the raindrops grow still heavier, they fall. The cold rain drags air with it creating a cold downdraft coexisting with the updraft; the cell has reached the mature stage.

The Mature Stage

Precipitation beginning to fall from the cloud base is your signal that a downdraft has developed, and a cell has entered the mature stage. Cold rain in the downdraft retards compressional heating, and the downdraft remains cooler than the surrounding air. Therefore, its downward speed is accelerated and may exceed 2,500 feet per minute. The down rushing air spreads outward at the surface, as shown in **Figure 5–9** producing strong, gusty surface winds, a sharp temperature drop, and a rapid rise in pressure. The surface wind surge is a "plow wind," and its leading edge is the "first gust." Meanwhile, updrafts reach a maximum with speeds possibly exceeding 6,000 feet per minute.

Updrafts and downdrafts in close proximity create strong vertical shear and a very turbulent environment. All thunderstorm hazards reach their greatest intensity during the mature stage.

The Dissipating Stage

Downdrafts characterize the dissipating stage of the thunderstorm cell, as shown in **Figure 5–9**, and the storm dies rapidly. When rain has ended and downdrafts have abated, the dissipating stage 'is complete. When all cells of the thunderstorm have completed this stage, only harmless cloud remnants remain.

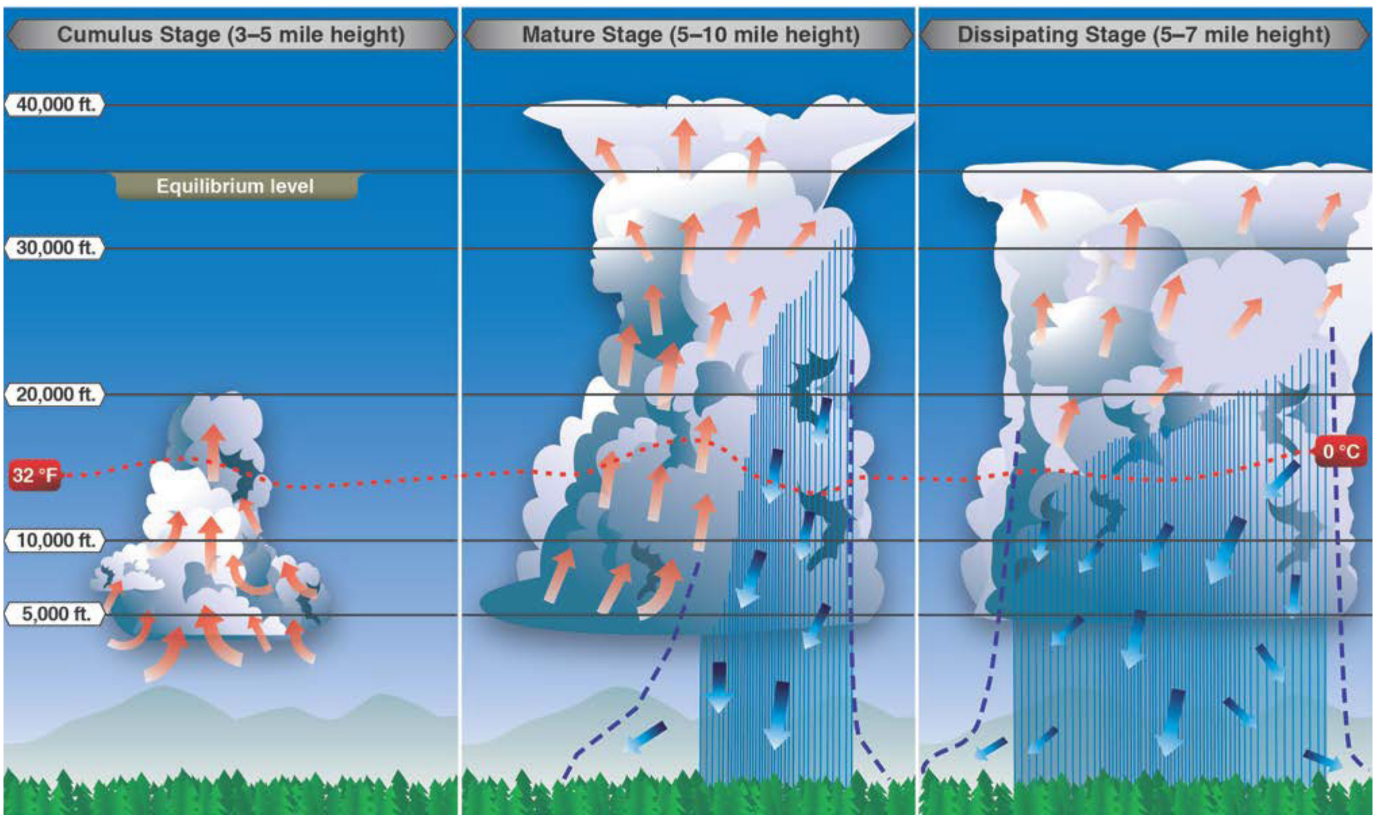

Figure 5–9. The life cycle of a thunderstorm.

Standing Lenticular Altocumulus Clouds.

Standing lenticular altocumulus clouds are formed on the crests of waves created by barriers in the wind flow. These lens-shaped clouds show little movement; hence the name standing. Wind, however, can be quite strong blowing through such clouds. They are characterized by their smooth, polished edges. The presence of these clouds is a good indication of very strong turbulence and should be avoided. When planning a flight over mountainous terrain, gather as much preflight information as possible on cloud reports, wind direction, wind speed, and stability of the air. Satellites often help locate mountain waves. Adequate information may not always be available, so remain alert for signposts in the sky.

Mountain Flying

Wind at mountain top level in excess of 25 knots suggests some turbulence. Wind in **excess of 40 knots** across a mountain barrier dictates caution. Stratified clouds mean stable air. **Standing lenticular** and/or rotor clouds suggest a **mountain wave**; expect turbulence many miles to the lee of mountains and relatively smooth flight on the windward side. Convective clouds on the windward side of mountains mean unstable air; expect turbulence in close proximity to and on either side of the mountain.

Ceiling

For aviation purposes, a ceiling is the lowest layer of clouds reported as being broken or overcast or the vertical visibility into an obscuration like fog or haze. Clouds are reported as **broken** when five-eighths to seven-eighths of the sky is covered with clouds. **Overcast** means the entire sky is covered with clouds. Current ceiling information is reported by the aviation routine weather report (METAR) and automated weather stations of various types.

Visibility

Closely related to cloud cover and reported ceilings is visibility information. Visibility refers to the greatest horizontal distance at which prominent objects can be viewed with the naked eye. Current visibility is also reported in METAR and other aviation weather reports, as well as by automated weather systems. Visibility information, as predicted by meteorologists, is available for a pilot during a preflight weather briefing.

Surface Aviation Weather Observations

In aviation, weather service is a combined effort of the National Weather Service (NWS), Federal Aviation Administration (FAA), Department of Defense (DOD), other aviation groups, and individuals. Because of the increasing need for worldwide weather services, foreign weather organizations also provide vital input. While weather forecasts are not 100 percent accurate, meteorologists, through careful scientific study and computer modeling, have the ability to predict weather patterns, trends, and characteristics with increasing accuracy. Through a complex system of weather services, government agencies, and independent weather observers, pilots, and other aviation professionals receive the benefit of this vast knowledge base in the form of up-to-date weather reports and forecasts. These reports and forecasts enable pilots to make informed decisions regarding weather and flight safety before and during a flight.

Surface aviation weather observations are a compilation of elements of the current weather at individual ground stations across the United States. The network is made up of government and privately contracted facilities that provide continuous up-to-date weather information. Automated weather sources, such as the **Automated Weather Observing Systems (AWOS)**, **Automated Surface Observing Systems (ASOS)**, as well as other automated facilities, also play a major role in the gathering of surface observations.

Surface observations provide local weather conditions and other relevant information for a specific airport. This information includes the type of report, station identifier, date and time, modifier (as required), wind, visibility, runway visual range (RVR), weather phenomena, sky condition, temperature/dew point, altimeter reading, and applicable remarks. The information gathered for the surface observation may be from a person, an automated station, or an automated station that is updated or enhanced by a weather observer. In any form, the surface observation provides valuable information about individual airports around the country. These reports cover a small area and will be beneficial to the remote pilot.

Aviation Weather Reports

Aviation weather reports are designed to give accurate depictions of **current** weather conditions. Each report provides current information that is updated at different times. Some typical reports are METARs and PIREPs. To view a weather report, go to ***http://www.aviationweather.gov***

Aviation Routine Weather Report (METAR)

A **METAR** is an observation of current surface weather reported in a standard international format. METARs are issued on a regularly scheduled basis unless significant weather changes have occurred. A special **METAR (SPECI)** can be issued at any time between routine METAR reports.

Example: METAR KGGG 161753Z AUTO 14021G26KT 3/4SM +TSRA R KN008 OVC012CB 18/17 A2970 RMKPRESFR

A typical METAR report contains the following information in sequential order:

1. **Type of report**—there are two types of METAR reports. The first is the routine METAR report that is transmitted on a regular time interval. The second is the aviation selected SPECI. This is a special report that can be given at any time to update the METAR for rapidly changing weather conditions, aircraft mishaps, or other critical information.
2. **Station identifier**—a four-letter code as established by the International Civil Aviation Organization (ICAO). In the 48 contiguous states, a unique three-letter identifier is preceded by the letter "**K**." For example, Gregg County Airport in Longview, Texas, is identified by the letters "KGGG," K being the country designation, and GGG being the airport identifier. In other regions of the world, including Alaska and Hawaii, the first two letters of the four-letter ICAO identifier indicate the region, country, or state. Alaska identifiers always begin with the letters "PA," and Hawaii identifiers always begin with the letters "PH." Station identifiers can be found by searching various websites such as DUATS and NOAA's Aviation Weather Aviation Digital Data Services(ADDS).

3. **Date and time of the report**—depicted in a six-digit group (161753Z). The first two digits are the date. The last four digits are the time of the METAR/SPECI, which is always given in coordinated universal time (UTC). A "Z" is appended to the end of the time to denote the time is given in Zulu time (UTC) as opposed to local time.
4. **Modifier**—denotes that the METAR/SPECI came from an automated source or that the report was corrected. If the notation "AUTO" is listed in the METAR/SPECI, the report came from an automated source. It also lists "AO1" (for no precipitation discriminator) or "AO2" (with precipitation discriminator) in the "Remarks" section to indicate the type of precipitation sensors employed at the automated station. When the modifier "COR" is used, it identifies a corrected report sent out to replace an earlier report that contained an error (for example, METAR KGGG 161753ZCOR).
5. **Wind**—reported with five digits (14021KT) unless the speed is greater than 99 knots, in which case the wind is reported with six digits. The first three digits indicate the **direction** the true wind is blowing from in tens of degrees. If the wind is variable, it is reported as "**VRB**." The last two digits indicate the speed of the wind in **knots** unless the wind is greater than 99 knots, in which case it is indicated by three digits. If the winds are gusting, the letter "**G**" follows the wind speed (G26KT). After the letter "G," the peak gust recorded is provided. If the wind direction varies more than 60° and the wind speed is greater than six knots, a separate group of numbers, separated by a "V," will indicate the extremes of the wind directions.
6. **Visibility**—the prevailing visibility (¾ SM) is reported in statute miles as denoted by the letters "**SM**." It is reported in both miles and fractions of miles. At times, the runway visual range (RVR) is reported following the prevailing visibility. RVR is the distance a pilot can see down the runway in a moving aircraft. When RVR is reported, it is shown with an R, then the runway number followed by a slant, then the visual range in feet. For example, when the RVR is reported as R17L/1400FT, it translates to a visual range of 1,400 feet on runway 17left.
7. **Weather**—can be broken down into two different categories: **qualifiers** and **weather phenomena** (+TSRA BR). First, the qualifiers of intensity, proximity, and the descriptor of the weather are given. The intensity may be light (**–**), moderate ( ), or heavy (**+**). Proximity only depicts weather phenomena that are in the airport vicinity. The notation "VC" indicates a specific weather phenomenon is in the vicinity of five to ten miles from the airport. Descriptors are used to describe certain types of precipitation and obscurations. Weather phenomena may be reported as being precipitation, obscurations, and other phenomena, such as squalls or funnel clouds. Descriptions of weather phenomena as they begin or end and hailstone size are also listed in the "**Remarks**" sections of the report. [**Figure 5–10**]

Qualifer		Weather Phenomena		
Intensity or Proximity 1	**Descriptor 2**	**Precipitation 3**	**Obscuration 4**	**Other 5**
– Light	**MI** Shallow	**DZ** Drizzle	**BR** Mist	**PO** Dust/sand whirls
Moderate (no qualifier)	**BC** Patches	**RA** Rain	**FG** Fog	**SQ** Squalls
+ Heavy	**DR** Low Drifting	**SN** Snow	**FU** Smote	**FC** Funnel cloud
VC in the vicinity	**BL** Blowing	**SG** Snow grains	**DU** Dust	**+FC** Tornado or waterspout
	SH Showers	**IC** Ice crystals (diamond dust)	**SA** Sand	**SS** Sandstorm
	TS Thunderstorms	**PL** Ice pellets	**HZ** Haze	**DS** Dust storm
	FZ Freezing	**GR** Hail	**PY** Spray	
	PR Partial	**GS** Small hail or snow pellets	**VA** Volcanic ash	
		UP *Unknown precipitation		

The weather groups are constructed by considering columns 1–5 in this table in sequence:

intensity, followed by descriptor, followed by weather phenomena (e.g., heavy rain showers coded as +SHRA).

* Automated stations only

Figure 5–10. Descriptors and weather phenomena used in a typical METAR.

8. **Sky condition**—always reported in the sequence of amount, height, and type or indefinite ceiling/height (vertical visibility) (BKN008 OVC012CB, VV003). The heights of the cloud bases are reported with a three-digit number in hundreds of feet **AGL**. Clouds above 12,000 feet **are not** detected or reported by an automated station. The types of

clouds, specifically towering cumulus (TCU) or cumulonimbus (CB) clouds, are reported with their height. Contractions are used to describe the amount of cloud coverage and obscuring phenomena. The amount of sky coverage is reported in eighths of the sky from horizon to horizon. [**Figure 5–11**]

Sky Cover	Contraction
Less than 1/8 (Clear)	SKC, CLR, FEW
1/8—2/8 (Few)	FEW
3/8—4/8 (Scattered)	SCT
5/8—7/8 (Broken)	BKN
8/8 (Overcast)	OVC

Figure 5–11. Reportable contractions for sky condition.

9. **Temperature and dew point**—the air temperature and dew point are always given in degrees Celsius (C) or (18/17). Temperatures below 0 °C are preceded by the letter "M" to indicate minus.
10. **Altimeter setting**—reported as inches of mercury ("Hg) in a four-digit number group (A2970). It is always preceded by the letter "A." Rising or falling pressure may also be denoted in the "Remarks" sections as "PRESRR" or "PRESFR,"respectively.
11. **Zulu time**—a term used in aviation for UTC, which places the entire world on a universal standard.
12. **Remarks**—the remarks section always begins with the letters "**RMK**." Comments may or may not appear in this section of the METAR. The information contained in this section may include wind data, variable visibility, beginning and ending times of particular phenomenon, pressure information, and various other information deemed necessary. An example of a remark regarding weather phenomenon that does not fit in any other category would be OCNL LTGICCG. This translates as occasional lightning in the clouds and from cloud to ground. Automated stations also use the remarks section to indicate the equipment needs maintenance.

Example: METAR KGGG 161753Z AUTO 14021G26KT 3/4SM +TSRA R BKN008 OVC012CB 18/17 A2970 RMKPRESFR

Explanation: Routine METAR for Gregg County Airport for the 16th day of the month at 1753Z automated source. Winds are 140 at 21 knots gusting to 26. Visibility is ¾ statute mile. Thunderstorms with heavy rain and mist. The ceiling is broken at 800 feet, overcast at 1,200 feet with cumulonimbus clouds. Temperature 18 °C and dew point 17 °C. Barometric pressure is 29.70 "Hg and falling rapidly.

Aviation Forecasts

Observed weather condition reports are often used in the creation of forecasts for the same area. A variety of different forecast products are produced and designed to be used in the preflight planning stage. The printed forecasts that pilots need to be familiar with are the **terminal aerodrome forecast (TAF)**, aviation area forecast (FA), inflight weather advisories (Significant Meteorological Information (SIGMET), Airman's Meteorological Information (AIRMET)), and the winds and temperatures aloft forecast (FB).

Terminal Aerodrome Forecasts (TAF)

A **TAF** is a report established for the five statute mile radius around an airport. TAF reports are usually given for larger airports. Each TAF is valid for a 24 or 30-hour time period and is updated four times a day at 0000Z, 0600Z, 1200Z, and 1800Z. The TAF utilizes the same descriptors and abbreviations as used in the METAR report. These weather reports can be beneficial to the remote pilot for flight planning purposes. The TAF includes the following information in sequential order:

1. Type of report—a TAF can be either a routine forecast (TAF) or an amended forecast (TAF AMD).
2. ICAO station identifier—the station identifier is the same as that used in a METAR.
3. Date and time of origin—time and date (081125Z) of TAF origination is given in the six-number code, with the first two being the date, the last four being the time. Time is always given in UTC as denoted by the Z following the time block.
4. Valid period dates and times—The TAF valid period (0812/0912) follows the date/time of the forecast origin group. Scheduled 24 and 30 hour TAFs are issued four times per day, at 0000, 0600, 1200, and 1800Z. The first two digits (08) are the day of the month for the start of the TAF. The next two digits (12) are the starting hour (UTC). 09 is the day of the month for the end of the TAF, and the last two digits (12) are the ending hour (UTC) of the valid period. A forecast period that begins at midnight UTC is annotated as 00. If the end time of a valid period is at midnight UTC, it is annotated as 24. For example, a 00Z TAF issued on the 9th of the month and valid for 24 hours would have a valid period of 0900/0924.
5. Forecast wind—the wind direction and speed forecast are coded in a five-digit number group. An example would be 15011KT. The first three digits indicate the direction of the wind in reference to true north. The last two digits state the wind speed in knots appended with "KT." Like the METAR, winds greater than 99 knots are given in three digits.
6. Forecast visibility—given in statute miles and can be in whole numbers or fractions. If the forecast is greater than six miles, it is coded as"P6SM."
7. Forecast significant weather—weather phenomena are coded in the TAF reports in the same format as the METAR.
8. Forecast sky condition—given in the same format as the METAR. Only CB clouds are forecast in this portion of the TAF report as opposed to CBs and towering cumulus in the METAR.
9. Forecast change group—for any significant weather change forecast to occur during the TAF time period, the expected conditions and time period are included in this group. This information may be shown as from (FM), and temporary (TEMPO). "FM" is used when a rapid and significant change, usually within an hour, is expected. "TEMPO" is used for temporary fluctuations of weather, expected to last less than 1hour.
10. PROB30—a given percentage that describes the probability of thunderstorms and precipitation occurring in the coming hours. This forecast is not used for the first 6 hours of the 24-hour forecast.

Example: TAF KPIR 111130Z 1112/1212 TEMPO 1112/1114 5SM BR FM1500 16015G25KT P6SM SCT040 BKN250 FM120000 14012KT P6SM BKN080 OVC150 PROB30 1200/1204 3SM TSRA BKN030CB M120400 1408KT P6SM SCT040 OVC080 TEMPO 1204/1208 3SM TSRA OVC030CB

Explanation: Routine TAF for Pierre, South Dakota…on the 11th day of the month, at 1130Z…valid for 24 hours from 1200Z on the 11th to 1200Z on the 12th…wind from 150° at 12 knots… visibility greater than 6 SM…broken clouds at 9,000 feet… temporarily, between 1200Z and 1400Z, visibility 5 SM in mist…from 1500Z winds from 160° at 15 knots, gusting to 25 knots visibility greater than 6 SM…clouds scattered at 4,000 feet and broken at 25,000 feet…from 0000Z wind from 140° at 12 knots…visibility greater than 6 SM…clouds broken at 8,000 feet, overcast at 15,000 feet…between 0000Z and 0400Z, there is a 30 percent probability of visibility 3 SM…thunderstorm with moderate rain showers…clouds are broken at 3,000 feet with cumulonimbus clouds…from 0400Z…winds from 140° at 8 knots…visibility greater than 6 miles…clouds at 4,000 scattered and overcast at 8,000… temporarily between 0400Z and 0800Z…visibility 3 miles… thunderstorms with moderate rain showers…clouds overcast at 3,000 feet with cumulonimbus clouds…end of the report(=).

Convective Significant Meteorological Information (WST)

Convective SIGMETs are issued for severe thunderstorms with surface winds greater than 50 knots, hail at the surface greater than or equal to ¾ inch in diameter, or tornadoes. They are also issued to advise pilots of embedded thunderstorms, lines of thunderstorms, or thunderstorms with heavy or greater precipitation that affect 40 percent or more of a 3,000 square mile or greater region. A remote pilot will find these weather alerts helpful for flight planning.

Sample Questions

Readers may locate the answers to the following questions in Appendix A. The sample questions in this book sometimes refer to figures from the ***FAA-CT-8080-2H Airman Knowledge Testing Supplement***. [1]

5001. If an unstable air mass is forced upward, what type of clouds can be expected?

A. Stratus clouds with little vertical development.

B. Stratus clouds with considerable associated turbulence.

C. Clouds with considerable vertical development and associated turbulence.

5002. The conditions necessary for the formation of cumulonimbus clouds are a lifting action and

A. unstable air containing an excess of condensation nuclei.

B. unstable, moist air.

C. either stable or unstable air.

5003. If the temperature/dewpoint spread is small and decreasing, and the temperature is 62 °F, what type of weather is most likely to develop?

A. Freezing precipitation.

B. Thunderstorms.

C. Fog or low clouds.

5004. (Refer to t.) In the TAF for KMEM, what does "SHRA" stand for?

A. Rain showers.

B. A shift in wind direction is expected.

C. A significant change in precipitation is possible.

5005. What are the characteristics of a moist, unstable air mass?

A. Cumuliform clouds and showery precipitation.

B. Poor visibility and smooth air.

C. Stratiform clouds and showery precipitation.

5006. While operating around buildings, the Remote Pilot in Command should be aware of the creation of wind gusts that:

A. Change rapidly in direction and speed, causing turbulence.

B. Increase the performance of the aircraft.

C. Enhance stability and imagery.

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1 URL: https://www.amazon.com/FAA-CT-8080-2H-Knowledge-Testing-Supplement-Recreational/dp/1674175949/

5007. The amount of water vapor which air can hold depends on the

A. dewpoint.

B. air temperature.

C. stability of the air.

5008. Possible mountain wave turbulence could be anticipated when winds of 40 knots or greater blow

A. across a mountain ridge and the air is stable.

B. down a mountain valley and the air is unstable.

C. parallel to a mountain peak and the air is stable.

5009. (**Refer to Figure 12**.) What are the wind conditions at Wink, Texas (KINK)?

A. Calm.

B. 110° at 12 knots, gusts 18 knots.

C. 111° at 2 knots, gusts 18 knots.

5010. For aviation purposes, the ceiling is defined as the height above the Earth's surface of the

A. lowest reported obscuration and the highest layer of clouds reported as overcast.

B. lowest broken or overcast layer or vertical visibility into an obscuration.

C. lowest layer of clouds reported as scattered, broken, or thin.

5011. An almond or lens-shaped cloud which appears stationary, but which may contain winds of 50 knots or more, is referred to as

A. an inactive frontal cloud.

B. a funnel cloud.

C. a lenticular cloud.

5012. What would decrease the stability of an air mass?

A. Warming from below.

B. Cooling from below.

C. Decrease in water vapor.

5013. What cloud types would indicate convective turbulence?

A. Cirrus clouds.

B. Nimbostratus clouds.

C. Towering cumulus clouds.

5014. What types of fog depend upon the wind in order to exist?

A. Radiation fog and ice fog.

B. Steam fog and ground fog.

C. Advection fog and upslope fog.

5015. At approximately what altitude above the surface would the pilot expect the base of cumuliform clouds if the surface air temperature is 82 °F and the dewpoint is 38 °F?

A. 9,000 feet AGL.

B. 10,000 feet AGL.

C. 11,000 feet AGL.

5016. One weather phenomenon which will always occur when flying across a front is a change in the

A. wind direction.

B. type of precipitation.

C. stability of the air mass.

5017. If there is thunderstorm activity in the vicinity of an airport at which you plan to land, which hazardous atmospheric phenomenon might be expected on the landing approach?

A. Precipitation static.

B. Wind-shear turbulence.

C. Steady rain.

5018. What are the standard temperature and pressure values for sea level?

A. 15 °C and 29.92 inches Hg.

B. 59 °C and 1013.2 millibars.

C. 59 °F and 29.92 millibars.

5019. Clouds are divided into four families according to their

A. outward shape.

B. height range.

C. composition.

5020. Thunderstorms reach their greatest intensity during the

A. mature stage.

B. downdraft stage.

C. cumulus stage.

5021. A stable air mass is most likely to have which characteristic?

A. Showery precipitation.

B. Turbulent air.

C. Smooth air.

5022. Which weather conditions should be expected beneath a low-level temperature inversion layer when the relative humidity is high?

A. Smooth air, poor visibility, fog, haze, or low clouds.

B. Light wind shear, poor visibility, haze, and light rain.

C. Turbulent air, poor visibility, fog, low stratus type clouds, and showery precipitation.

5023. What conditions are necessary for the formation of thunderstorms?

A. High humidity, lifting force, and unstable conditions.

B. High humidity, high temperature, and cumulus clouds.

C. Lifting force, moist air, and extensive cloud cover.

5024. What feature is normally associated with the cumulus stage of a thunderstorm?

A. Roll cloud.

B. Continuous updraft.

C. Frequent lightning.

5025. What are the characteristics of unstable air?

A. Turbulence and good surface visibility.

B. Turbulence, and poor surface visibility.

C. Nimbostratus clouds and good surface visibility.

5026. What is a characteristic of stable air?

A. Stratiform clouds.

B. Unlimited visibility.

C. Cumulus clouds.

5027. Where does wind shear occur?

A. Only at higher altitudes.

B. Only at lower altitudes.

C. At all altitudes, in all directions.

5028. What clouds have the greatest turbulence?

A. Towering cumulus.

B. Cumulonimbus.

C. Nimbostratus.

5029. (**Refer to Figure 12.**) The wind direction and velocity at KJFK is from

A. 180° true at 4 knots.

B. 180° magnetic at 4 knots.

C. 040° true at 18 knots.

5030. A pilot can expect a wind-shear zone in a temperature inversion whenever the wind speed at 2,000 to 4,000 feet above the surface is at least

A. 10 knots.

B. 15 knots.

C. 25 knots.

5031. A non-frontal, narrow band of active thunderstorms that often develop ahead of a cold front is known as a

A. prefrontal system.

B. squall line.

C. dry line.

5032. The presence of ice pellets at the surface is evidence that there

A. are thunderstorms in the area.

B. has been cold frontal passage.

C. is a temperature inversion with freezing rain at a higher altitude.

5033. One of the most easily recognized discontinuities across a front is

A. a change in temperature.

B. an increase in cloud coverage.

C. an increase in relative humidity.

5034. Clouds, fog, or dew will always form when

A. water vapor condenses.

B. water vapor is present.

C. relative humidity reaches 100 percent.

5035. One in-flight condition necessary for structural icing to form is

A. small temperature/dewpoint spread.

B. stratiform clouds.

C. visible moisture.

5036. Low-level turbulence can occur, and icing can become hazardous in which type of fog?

A. Rain-induced fog.

B. Upslope fog.

C. Steam fog.

5037. What are the characteristics of stable air?

A. Good visibility and steady precipitation.

B. Poor visibility and steady precipitation.

C. Poor visibility and intermittent precipitation.

5038. You have received an outlook briefing from flight service through 1800wxbrief.com. The briefing indicates you can expect a low-level temperature inversion with high relative humidity. What weather conditions would you expect when operating within the inversion?

A. Smooth air, poor visibility, fog, haze, or low clouds.

B. Light wind shear, poor visibility, haze, and light rain.

C. Turbulent air, poor visibility, fog, low stratus type clouds, and showery precipitation.

5039. What situation is most conducive to the formation of radiation fog?

A. Warm, moist air over low, flatland areas on clear, calm nights.

B. Moist, tropical air moving over cold, offshore water.

C. The movement of cold air over much warmer water.

5040. During the life cycle of a thunderstorm, which stage is characterized predominately by downdrafts?

A. Cumulus.

B. Dissipating.

C. Mature.

5041. An air mass moving inland from the coast in winter is likely to result in

A. rain.

B. fog.

C. frost.

5042. Every physical process of weather is accompanied by or is the result of, a

A. movement of air.

B. pressure differential.

C. heat exchange.

5043. The wind at 5,000 feet AGL is southwesterly while the surface wind is southerly. This difference in direction is primarily due to

A. stronger pressure gradient at higher altitudes.

B. friction between the wind and the surface.

C. stronger Coriolis force at the surface.

5044. Steady precipitation preceding a front is an indication of

A. stratiform clouds with moderate turbulence.

B. cumuliform clouds with little or no turbulence.

C. stratiform clouds with little or no turbulence.

5045. The boundary between two different air masses is referred to as a

A. frontolysis.

B. frontogenesis.

C. front.

Chapter 6: Risk Management

Aeronautical decision-making (ADM) is decision-making in a unique environment—aviation. It 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. It is what a pilot intends to do based on the latest information he or she has.

The importance of learning and understanding effective ADM skills cannot be overemphasized. While progress is continually being made in the advancement of pilot training methods, aircraft equipment and systems, and services for pilots, accidents still occur. Despite all the changes in technology to improve flight safety, one factor remains the same: the human factor, which leads to errors. It is estimated that approximately 80 percent of all aviation accidents are related to human factors and the vast majority of these accidents occur during **landing** (24.1 percent) and **takeoff** (23.4 percent).

ADM is a systematic approach to risk assessment and stress management. To understand ADM is also to understand how personal attitudes can influence decision-making and how those attitudes can be modified to enhance safety in the operation of a small UA. It is important to understand the factors that cause humans to make decisions and how the decision-making process not only works but can be improved.

History of ADM

For over 25 years, the importance of good pilot judgment, or aeronautical decision-making (ADM), has been recognized as critical to the safe operation of aircraft, as well as accident avoidance. The airline industry, motivated by the need to reduce accidents caused by human factors, developed the first training programs based on improving ADM. **Crew resource management (CRM)** training for flight crews is focused on the effective use of all available resources: human resources, hardware, and information supporting ADM to facilitate crew cooperation and improve decision-making. The goal of all flight crews is good ADM, and the use of CRM is one way to make good decisions.

Research in this area prompted the Federal Aviation Administration (FAA) to produce training directed at improving the decision-making of pilots and led to current FAA regulations that require that decision-making be taught as part of the pilot training curriculum. **Aeronautical Decision Making** and **Risk Management** are topics that the FAA is **required to test** an applicant for the issuance of a remote pilot certificate. ADM research, development, and testing culminated in 1987 with the publication of six manuals oriented to the decision-making needs of variously rated pilots. These manuals provided multifaceted materials designed to reduce the number of decision-related accidents. The effectiveness of these materials was validated in independent studies where student pilots received such training in conjunction with the standard flying curriculum. When tested, the pilots who had received ADM- training made fewer inflight errors than those who had not received ADM training. The differences were statistically significant and ranged from about 10 to 50 percent fewer judgment errors. In the operational environment, an operator flying about 400,000 hours annually demonstrated a 54 percent reduction in accident rate after using these materials for recurrency training.

Contrary to popular opinion, good judgment can be taught. Tradition held that good judgment was a natural by-product of experience, but as pilots continued to log accident-free flight hours, a corresponding increase of good judgment was assumed. Building upon the foundation of conventional decision-making, ADM enhances the process to decrease the probability of human error and increase the probability of a safe flight. ADM provides a structured, systematic approach to analyzing changes that occur during a flight and how these changes might affect the safe outcome of a flight. The ADM process addresses all aspects of decision-making and identifies the steps involved in good decision- making.

Steps for good decision-making are:

1. Identifying personal attitudes hazardous to safe flight.
2. Learning behavior modification techniques.
3. Learning how to recognize and cope with stress.
4. Developing risk assessment skills.
5. Using all the resources.
6. Evaluating the effectiveness of one's ADM skills.

Risk Management

The goal of **risk management** is to identify safety-related hazards and mitigate the associated risks proactively. Risk management is an important component of ADM. When a pilot follows good decision-making practices, the inherent risk in a flight is reduced or even eliminated. The ability to make good decisions is based upon direct or indirect experience and education. The formal risk management decision-making process involves six steps as shown in **Figure 6–1**.

Consider automotive seat belt use. In just two decades, seat belt use has become the norm, placing those who do not wear seat belts outside the norm, but this group may learn to wear a seat belt by either direct or indirect experience. For example, a driver learns through direct experience about the value of wearing a seat belt when he or she is involved in a car accident that leads to a personal injury. An indirect learning experience occurs when a loved one is injured during a car accident because he or she failed to wear a seat belt.

As you work through the ADM cycle, it is important to remember the four fundamental principles of risk management.

1. Accept no unnecessary risk. Flying is not possible without risk, but the unnecessary risk comes without a corresponding return.
2. Make risk decisions at the appropriate level. Risk decisions should be made by a person who can develop and implement risk controls.
3. Accept risk when benefits outweigh dangers (costs).
4. Integrate risk management into planning at all levels. Because risk is an unavoidable part of every flight, safety requires the use of appropriate and effective risk management not just in the preflight planning stage, but in all stages of the flight.

While poor decision-making in everyday life does not always lead to tragedy, the margin for error in aviation is thin. Since ADM enhances the management of an aeronautical environment, all pilots should become familiar with and employ ADM.

Figure 6–1: Risk management decision-making process.

Crew Resource Management (CRM) and Single-Pilot Resource Management

While CRM focuses on pilots operating in crew environments, many of the concepts apply to single-pilot operations. Many CRM principles have been successfully applied to single-pilot aircraft and led to the development of **Single-Pilot Resource Management (SRM)**. SRM is defined as the art and science of managing all the resources available to a single pilot (prior to and during flight) to ensure the successful outcome of the flight. SRM includes the concepts of ADM, risk management (RM), task management (TM), automation management (AM), controlled flight into terrain (CFIT) awareness, and situational awareness (SA). SRM training helps the pilot maintain situational awareness by managing the automation and associated aircraft control and navigation tasks. This enables the pilot to accurately assess and manage risk and make accurate and timely decisions.SRM is all about helping pilots learn how to gather information, analyze it, and make decisions.

Hazard and Risk

Two defining elements of ADM are **hazard** and **risk**. **Hazard** is a real or perceived condition, event, or circumstance that a pilot encounters. When faced with a hazard, the pilot makes an assessment of that hazard based upon various factors. The pilot assigns a value to the potential impact of the hazard, which qualifies the pilot's assessment of the hazard—**risk**.

Therefore, the **risk** is an assessment of the single or cumulative hazard facing a pilot; however, different pilots see hazards differently.

Hazardous Attitudes and Antidotes

Being fit to fly depends on more than just a pilot's physical condition and recent experience. For example, attitude affects the quality of decisions. **Attitude** is a motivational predisposition to respond to people, situations, or events in a given manner. Studies have identified **five hazardous attitudes** that can interfere with the ability to make sound decisions and exercise authority properly: **anti-authority**, **impulsivity**, **invulnerability**, **macho**, and **resignation**. [**Figure 6–2**]

Hazardous attitudes contribute to poor pilot judgment but can be effectively counteracted by redirecting the hazardous attitude so that corrective action can be taken. Recognition of hazardous thoughts is the first step toward neutralizing them. After recognizing a thought as hazardous, the pilot should label it as hazardous, then state the corresponding antidote. Antidotes should be memorized for each of the hazardous attitudes so they automatically come to mind when needed.

The Five Hazardous Attitudes	Antidote
Anti-authority: "Don't tell me." This attitude is found in people who do not like anyone telling them what to do. In a sense, they are saying, "No one can tell me what to do." They may be resentful of having someone tell them what to do or may regard rules, regulations, and procedures as silly or unnecessary. However, it is always your prerogative to question authority if you feel it is in error.	**Follow the rules. They are usually right.**
Impulsivity: "Do it quickly." This is the attitude of people who frequently feel the need to do something, anything, immediately. They do not stop to think about what they are about to do, they do not select the best alternative, and they do the first thing that comes to mind.	**Not so fast. Think first.**
Invulnerability: "It won't happen to me." Many people falsely believe that accidents happen to others, but never to them. They know accidents can happen, and they know that anyone can be affected. However, they never really feel or believe that they will be personally involved. Pilots who think this way are more likely to take chances and increase risk.	**It could happen to me.**
Macho: "I can do it." Pilots who are always trying to prove that they are better than anyone else think, "I can do it—I'll show them." Pilots with this type of attitude will try to prove themselves by taking risks in order to impress others. While this pattern is thought to be a male characteristic, women are equally susceptible.	**Taking chances is foolish.**
Resignation: "What's the use?" Pilots who think, "What's the use?" do not see themselves as being able to make a great deal of difference in what happens to them. When things go well, the pilot is apt to think that it is good luck. When things go badly, the pilot may feel that someone is out to get them or attribute it to bad luck. The pilot will leave the action to others, for better or worse. Sometimes, such pilots will even go along with unreasonable requests just to be a "nice guy."	**I'm not helpless. I can make a difference.**

Figure 6–2: The five hazardous attitudes identified through the past and contemporary study.

Risk

During each flight, the single pilot makes many decisions under hazardous conditions. To fly safely, the pilot needs to assess the degree of risk and determine the best course of action to mitigate the risk.Assessing Risk

For the single pilot, assessing risk is not as simple as it sounds. For example, the pilot acts as his or her own quality control in making decisions. If a fatigued pilot who has flown 16 hours is asked if he or she is too tired to continue flying, the answer may be "no." Most pilots are goal-oriented and when asked to accept a flight, there is a tendency to deny personal limitations while adding weight to issues not germane to the mission. For example, pilots of helicopter emergency services (EMS) have been known (more than other groups) to make flight decisions that add significant weight to the patient's welfare. These pilots add weight to intangible factors (the patient in this case) and fail to quantify actual hazards, such as fatigue or weather, appropriately when making flight decisions. The single-pilot who has no other crew member for consultation must wrestle with the intangible factors that draw one into a hazardous position. Therefore, he or she has a greater vulnerability than a full crew.

Mitigating Risk

Risk assessment is only part of the equation. One of the best ways single pilots can mitigate risk is to use the IMSAFE checklist to determine physical and mental readiness for flying:

1. **Illness**—Am I sick? Illness is an obvious pilot risk.
2. **Medication**—Am I taking any medicines that might affect my judgment or make me drowsy?
3. **Stress**—Am I under psychological pressure from the job? Do I have money, health, or family problems? Stress causes concentration and performance problems. While the regulations list medical conditions that require grounding, stress is not among them. The pilot should consider the effects of stress on performance.
4. **Alcohol**—Have I been drinking within 8 hours? Within 24 hours? As little as one ounce of liquor, one bottle of beer, or four ounces of wine can impair flying skills. Alcohol also renders a pilot more susceptible to disorientation and hypoxia.
5. **Fatigue**—Am I tired and not adequately rested? Fatigue continues to be one of the most insidious hazards to flight safety, as it may not be apparent to a pilot until serious errors are made.
6. **Emotion**—Am I emotionally upset?

The PAVE Checklist

Another way to mitigate risk is to perceive hazards. By incorporating the **PAVE** checklist into preflight planning, the pilot divides the risks of flight into four categories: **Pilot-in-command (PIC)**, **Aircraft**, **enVironment**, and **External pressures** (**PAVE**) which form part of a pilot's decision-making process. With the PAVE checklist, pilots have a simple way to remember each category to examine for risk prior to each flight.

Once a pilot identifies the risks of a flight, he or she needs to decide whether the risk or combination of risks can be managed safely and successfully. If not, make the decision to cancel the flight. If the pilot decides to continue with the flight, he or she should develop strategies to mitigate the risks. One way a pilot can control the risks is to set personal minimums for items in each risk category. These are limits unique to that individual pilot's current level of experience and proficiency.

P = Pilot-in-Command (PIC)

The pilot is one of the risk factors in a flight. The pilot must ask, "Am I ready for this flight?" in terms of experience, recency, currency, physical, and emotional condition. The IMSAFE checklist provides the answers.

A = Aircraft

What limitations will the aircraft impose upon the trip? Ask the following questions:

- Is this the right aircraft for the flight?
- Am I familiar with and current in this aircraft?
- Can this aircraft carry the planned load?

V = EnVironment

Weather

Weather is a major environmental consideration. Earlier it was suggested pilots set their own personal minimums, especially when it comes to weather. As pilots evaluate the weather for a particular flight, they should consider the following:

- What is the current ceiling and visibility?
- Consider the possibility that the weather may be different than the forecast.
- Are there any thunderstorms present or forecast?
- If there are clouds, is there any icing, current or forecast? What are the temperature/dew point spread and the current temperature at altitude?

Terrain

Evaluation of terrain is another important component of analyzing the flight environment.

Airspace

Check the airspace and any temporary flight restriction (TFRs).

E = External Pressures

External pressures are influences external to the flight that create a sense of pressure to complete a flight—often at the expense of safety. Factors that can be external pressures include the following:

- The desire to demonstrate pilot qualifications
- The desire to impress someone (Probably the two most dangerous words in aviation are “Watch this!”)
- The pilot’s general goal-completion orientation
- Emotional pressure associated with acknowledging that skill and experience levels may be lower than a pilot would like them to be. Pride can be a powerful external factor!

Managing External Pressures

Management of external pressure is the single most important key to risk management because it is the one risk factor category that can cause a pilot to ignore all the other risk factors. The use of personal **standard operating procedures (SOPs)** is one way to manage external pressures. The goal is to supply a release for the external pressures of a flight.

Human Factors

Why are human conditions, such as fatigue, complacency, and stress, so important in aviation? These conditions, along with many others, are called human factors. Human factors directly cause or contribute to many aviation accidents and have been documented as a primary contributor to more than 70 percent of aircraft accidents.

Typically, human factor incidents/accidents are associated with flight operations but recently have also become a major concern in aviation maintenance and air traffic management as well. Over the past several years, the FAA has made the study

and research of human factors a top priority by working closely with engineers, pilots, mechanics, and ATC to apply the latest knowledge about human factors in an effort to help operators and maintainers improve safety and efficiency in their daily operations.

Human factors science, or human factors technologies, is a multidisciplinary field incorporating contributions from psychology, engineering, industrial design, statistics, operations research, and anthropometry. It is a term that covers the science of understanding the properties of human capability, the application of this understanding to the design, development, and deployment of systems and services, and the art of ensuring successful application of human factor principles into all aspects of aviation to include pilots, ATC, and aviation maintenance. Human factors are often considered synonymous with CRM or maintenance resource management (MRM) but are really much broader in both its knowledge base and scope. Human factors involve gathering research specific to certain situations (i.e., flight, maintenance, stress levels, knowledge) about human abilities, limitations, and other characteristics and applying it to tool design, machines, systems, tasks, jobs, and environments to produce safe, comfortable, and effective human use. The entire aviation community benefits greatly from human factors research and development as it helps better understand how humans can most safely and efficiently perform their jobs and improve the tools and systems in which they interact.

The Decision-Making Process

An understanding of the decision-making process provides the pilot with a foundation for developing ADM and SRM skills. While some situations, such as engine failure, require an immediate pilot response using established procedures, there is usually time during a flight to analyze any changes that occur, gather information, and assess risks before reaching a decision.

Risk management and risk intervention are much more than the simple definitions of the terms might suggest. Risk management and risk intervention are decision-making processes designed to systematically identify hazards, assess the degree of risk, and determine the best course of action. These processes involve the identification of hazards, followed by assessments of the risks, analysis of the controls, making control decisions, using the controls, and monitoring the results.

The steps leading to this decision constitute a decision-making process. Three models of a structured framework for problem-solving and decision-making are the **5P**, the **3P** using **PAVE**, CARE and TEAM, and the **DECIDE** models. They provide assistance in organizing the decision process. All these models have been identified as helpful to the single pilot in organizing critical decisions.

Single-Pilot Resource Management (SRM)

Single-Pilot Resource Management (SRM) is about how to gather information, analyze it, and make decisions. Learning how to identify problems, analyze the information, and make informed and timely decisions is not as straightforward as the training involved in learning specific maneuvers. Learning how to judge a situation and "how to think" in the endless variety of situations encountered while flying out in the "real world" is more difficult. There is no one right answer in ADM; rather, each pilot is expected to analyze each situation in light of experience level, personal minimums, and current physical and mental readiness level, and make his or her own decision.

Perceive, Process, Perform (3P) Model

The Perceive, Process, Perform (3P) model for ADM offers a simple, practical, and systematic approach that can be used during all phases of flight. To use it, the pilot will:

- **Perceive** the given set of circumstances for a flight
- **Process** by evaluating their impact on flight safety
- **Perform** by implementing the best course of action

Use the Perceive, Process, Perform, and Evaluate method as a continuous model for every aeronautical decision that you make. Although human beings will inevitably make mistakes, anything that you can do to recognize and minimize potential threats to your safety will make you a better pilot.

Depending upon the nature of the activity and the time available, risk management processing can take place in any of the three timeframes. [**Figure 6–3**] Most flight training activities take place in the "time-critical" timeframe for risk management. The six steps of risk management can be combined into an easy-to-remember 3P model for practical risk management: Perceive, Process, Perform with the PAVE, CARE and TEAM checklists. Pilots can help perceive hazards by using the PAVE checklist of Pilot, Aircraft, enVironment, and External pressures. They can process hazards by using the CARE checklist of Consequences, Alternatives, Reality, External factors. Finally, pilots can perform risk management by using the TEAM choice list of Transfer, Eliminate, Accept, or Mitigate.

	Strategic	Deliberate	Time-Critical
Purpose	Used in a complex operation (e.g., introduction of new equipment); involves research, use of analysis tools, formal testing, or long term tracking of risks.	Uses experience and brainstorming to identify hazards, assess risks, and develop controls for planning operations, review of standard operating or training procedures, etc.	"On the fly" mental or verbal review using the basic risk management process during the execution phase of an activity.

Figure 6–3: Risk management processing can take place in any of the three timeframes.

PAVE Checklist: Identify Hazards and Personal Minimums

In the first step, the goal is to develop situational awareness by perceiving hazards, which are present events, objects, or circumstances that could contribute to an undesired future event. In this step, the pilot will systematically identify and list hazards associated with all aspects of the flight: Pilot, Aircraft, enVironment, and External pressures, which makes up the PAVE checklist. [**Figure 6–4**] All four elements combine and interact to create a unique situation for any flight. Pay special attention to the pilot-aircraft combination, and consider whether the combined "pilot-aircraft team" is capable of the mission you want to fly. For example, you may be a very experienced and proficient pilot, but your weather flying ability is still limited if you are flying an unfamiliar aircraft. On the other hand, you may have a new technically advanced aircraft that you have flown for a considerable amount of time.

Pilots can perceive hazards by using the PAVE checklist:

Pilot

Gayle is a healthy and well-rested private pilot with approximately 300 hours total flight time. Hazards include her lack of overall and cross-country experience and the fact that she has not flown at all in 2 months.

Aircraft

Although it does not have a panel-mount GPS or weather avoidance gear, the aircraft—a C182 Skylane with long-range fuel tanks—is in good mechanical condition with no inoperative equipment. The instrument panel is a standard "six-pack."

EnVironment

Departure and destination airports have long runways. Weather is the main hazard. Although it is VFR, it is a typical summer day in the Mid-Atlantic region: hot (near 90 °F) hazy (visibility 7 miles), and humid with a density altitude of 2,500 feet. Weather at the destination airport (located in the mountains) is still IMC but forecast to improve to visual meteorological conditions (VMC) prior to her arrival. En route weather is VMC, but there is an AIRMET Sierra for pockets of IMC over mountain ridges along the proposed route of flight.

External pressures

Gayle is making the trip to spend a weekend with relatives she does not see very often. Her family is very excited and has made a number of plans for the visit.

Figure 6–4: A real-world example of how the 3P model guides decisions on a cross-country trip using the PAVE checklist.

Decision-Making in a Dynamic Environment

A solid approach to decision-making is through the use of analytical models, such as the 5 Ps, 3P, and DECIDE. Good decisions result when pilots gather all available information, review it, analyze the options, rate the options, select a course of action, and evaluate that course of action for correctness.

In some situations, there is not always time to make decisions based on analytical decision-making skills. A good example is a quarterback whose actions are based upon a highly fluid and changing situation. He intends to execute a plan, but new circumstances dictate decision-making on the fly. This type of decision-making is called automatic decision-making or naturalized decision-making. [**Figure 6–5**]

Automatic Decision-Making

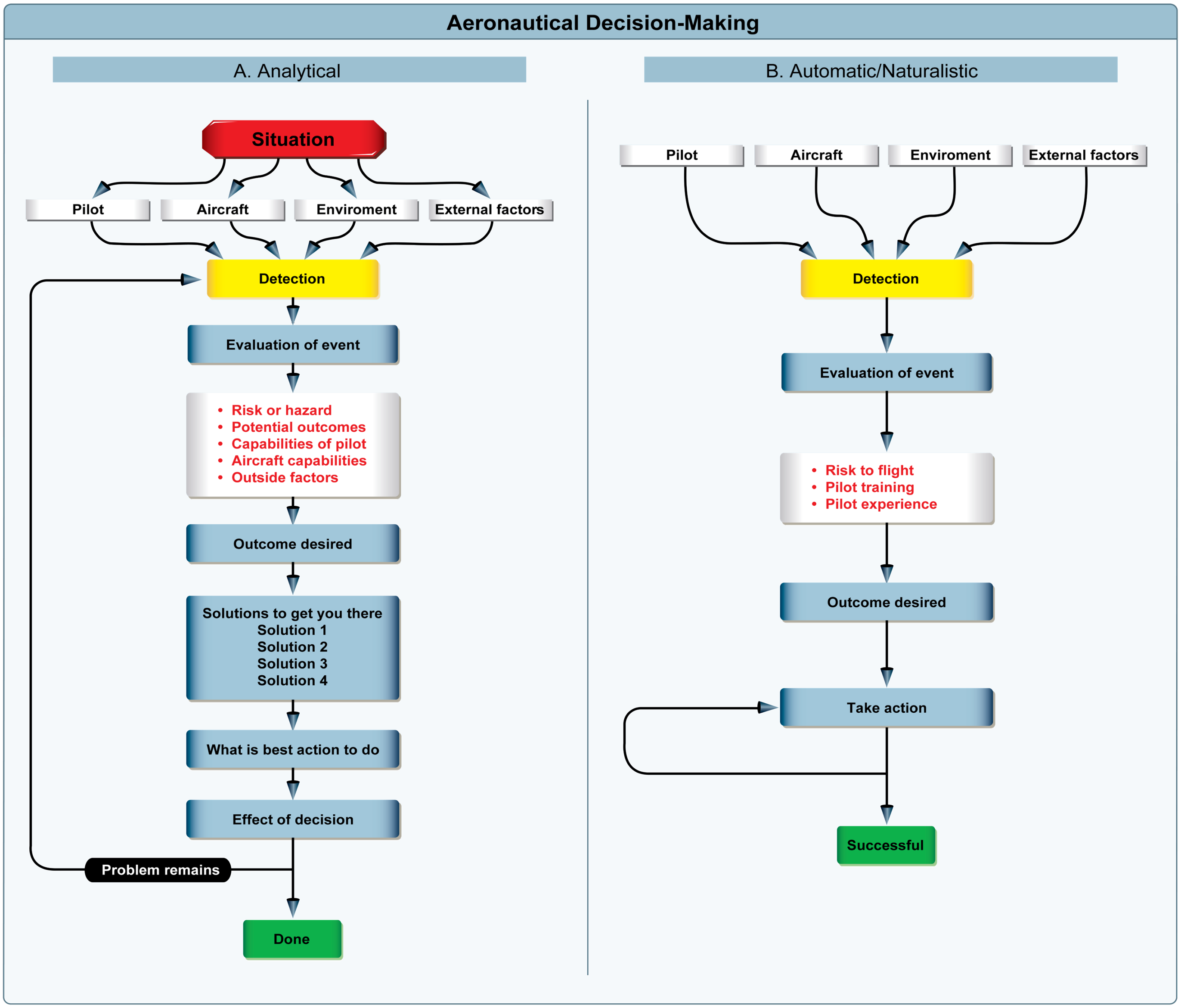
For the past several decades, research into how people actually make decisions has revealed that when pressed for time, experts faced with a task loaded with uncertainty first assess whether the situation strikes them as familiar. Rather than comparing the pros and cons of different approaches, they quickly imagine how one or a few possible courses of action in such situations will play out.

Experts take the first workable option they can find. While it may not be the best of all possible choices, it often yields remarkably good results.

The terms "naturalistic" and "automatic decision-making" have been coined to describe this type of decision-making. The ability to make automatic decisions holds true for a range of experts, from firefighters to chess players. It appears the expert's ability hinges on the recognition of patterns and consistencies that clarify options in complex situations. Experts appear to make provisional sense of a situation without actually reaching a decision by launching experience-based actions that in turn, trigger creative revisions.

This is a reflexive type of decision-making anchored in training and experience and is most often used in times of emergencies when there is no time to practice analytical decision-making.

Naturalistic or automatic decision-making improves with training and experience, and a pilot will find himself or herself using a combination of decision-making tools that correlate with individual experience and training.



The DECIDE model

1. **Detect.** The decision maker detects the fact that change has occurred.
2. **Estimate.** The decision maker estimates the need to counter or react to the change.
3. **Choose.** The decision maker chooses a desirable outcome (in terms of success) for the flight.
4 **Identify.** The decision maker identifies actions which could successfully control the change.
5. **Do.** The decision maker takes the necessary action.
6. **Evaluate.** The decision maker evaluates the effect(s) of his/her action countering the change.

Figure 6–5: The DECIDE model has been recognized worldwide. Its application is illustrated in column A while automatic/naturalistic decision-making is shown in column B.

Operational Pitfalls

Although more experienced pilots are likely to make more automatic decisions, there are tendencies or operational pitfalls that come with the development of pilot experience. These are classic behavioral traps into which pilots have been known to fall. More experienced pilots, as a rule, try to complete a flight as planned. The desire to meet these goals can have an adverse effect on safety and contribute to an unrealistic assessment of piloting skills. These dangerous tendencies or behavior patterns, which must be identified and eliminated, include the operational pitfalls shown in **Figure 6–6**.

Operational Pitfalls

Peer pressure
Poor decision-making may be based upon an emotional response to peers, rather than evaluating a situation objectively.

Mindset
A pilot displays mind set through an inability to recognize and cope with changes in a given situation.

Get-there-itis
This disposition impairs pilot judgment through a fixation on the original goal or destination, combined with a disregard for any alternative course of action.

Duck-under syndrome
A pilot may be tempted to make it into an airport by descending below minimums during an approach. There may be a belief that there is a built-in margin of error in every approach procedure, or a pilot may want to admit that the landing cannot be completed and a missed approach must be initiated.

Scud running
This occurs when a pilot tries to maintain visual contact with the terrain at low altitudes while instrument conditions exist.

Continuing visual flight rules (VFR) into instrument conditions
Spatial disorientation or collision with ground/obstacles may occur when a pilot continues VFR into instrument conditions. This can be even more dangerous if the pilot is not instrument rated or current.

Getting behind the aircraft
This pitfall can be caused by allowing events or the situation to control pilot actions. A constant state of surprise at what happens next may be exhibited when the pilot is getting behind the aircraft.

Loss of positional or situational awareness
In extreme cases, when a pilot gets behind the aircraft, a loss of positional or situational awareness may result. The pilot may not know the aircraft's geographical location or may be unable to recognize deteriorating circumstances.

Operating without adequate fuel reserves
Ignoring minimum fuel reserve requirements is generally the result of overconfidence, lack of flight planning, or disregarding applicable regulations.

Descent below the minimum en route altitude
The duck-under syndrome, as mentioned above, can also occur during the en route portion of an IFR flight.

Flying outside the envelope
The assumed high performance capability of a particular aircraft may cause a mistaken belief that it can meet the demands imposed by a pilot's overestimated flying skills.

Neglect of flight planning, preflight inspections, and checklists
A pilot may rely on short- and long-term memory, regular flying skills, and familiar routes instead of established procedures and published checklists. This can be particularly true of experienced pilots.

Figure 6–6: Typical operational pitfalls requiring pilot awareness.

Stress Management

Everyone is stressed to some degree, almost all of the time. A certain amount of stress is good since it keeps a person alert and prevents complacency. Effects of stress are cumulative and, if the pilot does not cope with them in an appropriate way, they can eventually add up to an intolerable burden. Performance generally increases with the onset of stress, peaks, and then begins to fall off rapidly as stress levels exceed a person's ability to cope. The ability to make effective decisions during flight can be impaired by stress. There are two categories of stress—acute and chronic. These are both explained in Chapter 9, "Physiological Factors (Including Drugs and Alcohol) Affecting Pilot Performance," of this study guide.

There are several techniques to help manage the accumulation of life stresses and prevent stress overload. For example, to help reduce stress levels, set aside time for relaxation each day, or maintain a program of physical fitness. To prevent stress overload, learn to manage time more effectively to avoid pressures imposed by getting behind schedule and not meeting deadlines.

Use of Resources

To make informed decisions during flight operations, a pilot must also become aware of the available resources. Since useful tools and sources of information may not always be readily apparent, learning to recognize these resources is an essential part of ADM training. Resources must not only be identified, but a pilot must also develop the skills to evaluate whether there is time to use a particular resource and the impact its use will have upon the safety of flight.

Stressors
Environmental Conditions associated with the environment, such as temperature and humidity extremes, noise, vibration, and lack of oxygen.
Physiological stress Physical conditions, such as fatigue, lack of physical fitness, sleep loss, missed meals (leading to low blood sugar levels), and illness.
Psychological stress Social or emotional factors, such as a death in the family, a divorce, a sick child, or a demotion at work. This type of stress may also be related to mental workload, such as analyzing a problem, navigating an aircraft, or making decisions.

Figure 6–7: System stressors. Environmental, physiological, and psychological stress are factors that affect the decision- making skills. These stressors have a profound impact especially during periods of high workload.

Situational Awareness

Situational awareness is the accurate perception and understanding of all the factors and conditions within the five fundamental risk elements (flight, pilot, aircraft, environment, and type of operation that comprise any given aviation situation) that affect safety before, during, and after the flight.

Maintaining situational awareness requires an understanding of the relative significance of all flight-related factors and their future impact on the flight. When a pilot understands what is going on and has an overview of the total operation, he or she is not fixated on one perceived significant factor. Not only is it important for a pilot to know the aircraft's geographical location, but it is also important he or she understands what is happening.

Obstacles to Maintaining Situational Awareness

Fatigue, stress, and work overload can cause a pilot to fixate on a single perceived important item and reduce an overall situational awareness of the flight. A contributing factor in many accidents is a distraction that diverts the pilot's attention from monitoring the aircraft.

Workload Management

Effective workload management ensures essential operations are accomplished by planning, prioritizing, and sequencing tasks to avoid work overload. As experience is gained, a pilot learns to recognize future workload requirements and can prepare for high workload periods during times of low workload.

In addition, a pilot should listen to ATIS, Automated Surface Observing System (ASOS), or Automated Weather Observing System (AWOS), if available, and then monitor the tower frequency or Common Traffic Advisory Frequency (CTAF) to get a good idea of what traffic conditions to expect.

Recognizing a work overload situation is also an important component of managing workload. The first effect of high workload is that the pilot may be working harder but accomplishing less. As workload increases, attention cannot be devoted to several tasks at one time, and the pilot may begin to focus on one item. When a pilot becomes task saturated, there is no awareness of input from various sources, so decisions may be made on incomplete information, and the possibility of error increases. When a work overload situation exists, a pilot needs to stop, think, slow down, and prioritize. It is important to understand how to decrease workload.

Physiological Factors (Including Drugs and Alcohol) Affecting Pilot Performance

14 CFR part 107 does not allow operation of small UA if the remote PIC, the person manipulating the controls, or Visual Observer (VO) is unable to carry out his or her responsibilities safely. It is the remote PIC's responsibility to ensure all crewmembers are not participating in the operation while impaired.

While drug and alcohol use is known to impair judgment, certain over-the-counter (OTC) medications and medical conditions could also affect the ability to operate a small UA safely. 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 another crewmember if he or she:

» Has 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

- Is using a drug that affects the person's mental or physical capabilities.

There are certain medical conditions, such as epilepsy, which 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 small UA operation.

Physiological/Medical Factors that Affect Pilot Performance

Important medical factors that a pilot should be aware of include the following:

- hyperventilation
- stress
- fatigue
- dehydration
- heatstroke
- the effects of alcohol and drugs

Hyperventilation

Hyperventilation is the excessive rate and depth of respiration, leading to abnormal loss of carbon dioxide from the blood. This condition occurs more often among pilots than is generally recognized. It seldom incapacitates completely, but it causes disturbing symptoms that can alarm the uninformed pilot. In such cases, increased breathing rate and anxiety further aggravate the problem. Hyperventilation can lead to unconsciousness due to the respiratory system's overriding mechanism to regain control of breathing. Pilots encountering an unexpected stressful situation may subconsciously increase their breathing rate.

- Common symptoms of hyperventilation include:
- Visual impairment
- Unconsciousness
- Lightheaded or dizzy sensation
- Tingling sensations
- Hot and cold sensations
- Muscle spasms

The treatment for hyperventilation involves restoring the proper carbon dioxide level in the body. Breathing normally is both the best prevention and the best cure for hyperventilation. In addition to slowing the breathing rate, breathing into a paper bag or talking aloud helps to overcome hyperventilation. Recovery is usually rapid once the breathing rate is returned to normal.

Stress

Stress is the body's response to physical and psychological demands placed upon it. The body's reaction to stress includes releasing chemical hormones (such as adrenaline) into the blood and increasing metabolism to provide more energy to the muscles. Blood sugar, heart rate, respiration, blood pressure, and perspiration all increase. The term "stressor" is used to describe an element that causes an individual to experience stress. Examples of stressors include physical stress (noise or vibration), physiological stress (fatigue), and psychological stress (difficult work or personal situations).

Stress falls into two broad categories: acute (short term) and chronic (long term). Acute stress involves an immediate threat that is perceived as a danger. This is the type of stress that triggers a "fight or flight" response in an individual, whether the threat is real or imagined. Normally, a healthy person can cope with acute stress and prevent stress overload. However, ongoing acute stress can develop into chronic stress.

Chronic stress can be defined as a level of stress that presents an intolerable burden, exceeds the ability of an individual to cope, and causes individual performance to fall sharply. Unrelenting psychological pressures, such as loneliness, financial worries, and relationship or work problems, can produce a cumulative level of stress that exceeds a person's ability to cope with the situation. When stress reaches these levels, performance falls off rapidly. Pilots experiencing this level of stress are not safe and should not exercise their airman privileges. Pilots who suspect they are suffering from chronic stress should consult a physician.

Fatigue

Fatigue is frequently associated with pilot error. Some of the effects of fatigue include degradation of attention and concentration, impaired coordination, and decreased ability to communicate.

These factors seriously influence the ability to make effective decisions. Physical fatigue results from sleep loss, exercise, or physical work. Factors such as stress and prolonged performance of cognitive work result in mental fatigue.

Like stress, fatigue falls into two broad categories: acute and chronic. Acute fatigue is short term and is a normal occurrence in everyday living. It is the kind of tiredness people feel after a period of strenuous effort, excitement, or lack of sleep. Rest after exertion and 8 hours of sound sleep ordinarily cures this condition.

A special type of acute fatigue is skill fatigue. This type of fatigue has two main effects on performance:

- Timing disruption—appearing to perform a task as usual, but the timing of each component is slightly off. This makes the pattern of the operation less smooth because the pilot performs each component as though it were separate, instead of part of integrated activity.
- Disruption of the perceptual field—concentrating attention upon movements or objects in the center of vision and neglecting those in the periphery. This is accompanied by a loss of accuracy and smoothness in control movements.

Acute fatigue has many causes, but the following are among the most important for the pilot:

- Mild hypoxia (oxygen deficiency)
- Physical stress
- Psychological stress
- Depletion of physical energy resulting from psychological stress
- Sustained psychological stress

Acute fatigue can be prevented by proper diet and adequate rest and sleep. A well-balanced diet prevents the body from needing to consume its own tissues as an energy source. Adequate rest maintains the body's store of vital energy.

Chronic fatigue, extending over a long period of time, usually has psychological roots, although an underlying disease is sometimes responsible. Continuous high-stress levels produce chronic fatigue. Chronic fatigue is not relieved by proper diet and adequate rest and sleep and usually requires treatment by a physician. An individual may experience this condition in the form of weakness, tiredness, palpitations of the heart, breathlessness, headaches, or irritability. Sometimes chronic fatigue even creates stomach or intestinal problems and generalized aches and pains throughout the body. When the condition becomes serious enough, it leads to emotional illness.

If suffering from acute fatigue, a remote pilot should not operate a small UA. If fatigue occurs during the operation of a small UA, no amount of training or experience can overcome the detrimental effects. Getting adequate rest is the only way to prevent fatigue from occurring. Avoid flying a small UA without a full night's rest, after working excessive hours, or after an especially exhausting or stressful day. Remote pilots who suspect they are suffering from chronic fatigue should consult a physician.

Dehydration

Dehydration is the term given to a critical loss of water from the body. Causes of dehydration are hot temperatures, wind, humidity, and diuretic drinks—coffee, tea, alcohol, and caffeinated soft drinks. Some common signs of dehydration are headache, fatigue, cramps, sleepiness, and dizziness.

The first noticeable effect of dehydration is fatigue, which in turn makes top physical and mental performance difficult, if not impossible. Flying a small UA for long periods in hot summer temperatures or at high altitudes increases the susceptibility to dehydration because these conditions tend to increase the rate of water loss from the body.

To help prevent dehydration, drink two to four quarts of water every 24 hours. Since each person is physiologically different, this is only a guide. Most people are aware of the eight-glasses-a-day guide: If each glass of water is eight ounces, this equates to 64 ounces, which is two quarts. If this fluid is not replaced, fatigue progresses to dizziness, weakness, nausea, tingling of hands and feet, abdominal cramps, and extreme thirst.

The key for pilots is to be continually aware of their condition. Most people become thirsty with a 1.5-quart deficit or a loss of 2 percent of total body weight. This level of dehydration triggers the "thirst mechanism." The problem is that the thirst mechanism arrives too late and is turned off too easily. A small amount of fluid in the mouth turns this mechanism off and the replacement of needed body fluid is delayed.

Other steps to prevent dehydration include:

- » Carrying a container in order to measure daily water intake.
- » Staying ahead—not relying on the thirst sensation as an alarm. If plain water is not preferred, add some sports drink flavoring to make it more acceptable.
- » Limiting daily intake of caffeine and alcohol (both are diuretics and stimulate increased production of urine).

Heatstroke

Heatstroke is a condition caused by an inability of the body to control its temperature. The onset of this condition may be recognized by the symptoms of dehydration, but also has been known to be recognized only upon complete collapse.

It is recommended that an ample supply of water be carried and used at frequent intervals, whether thirsty or not to prevent these symptoms. The body normally absorbs water at a rate of 1.2 to 1.5 quarts per hour. Individuals should drink one quart per hour for severe heat stress conditions or one pint per hour for moderate stress conditions. For more information on water consumption, refer to the "Dehydration" section of this chapter.

Drugs

The Federal Aviation Regulations include no specific references to medication usage. Title 14 of the CFR prohibits acting as PIC or in any other capacity as a required pilot flight crewmember, while that person:

1. Knows or has reason to know of any medical condition that would make the person unable to meet the requirement for the medical certificate necessary for the pilot operation, or
2. Is taking medication or receiving other treatment for a medical condition that results in the person being unable to meet the requirements for the medical certificate necessary for the pilot operation.

Further, 14 CFR part 107 and 14 CFR part 91, sections 91.17 and 91.19 prohibit the use of any drug that affects the person's faculties in any way contrary to safety.

There are several thousand medications currently approved by the U.S. Food and Drug Administration (FDA), not including OTC drugs. Virtually all medications have the potential for adverse side effects in some people. Additionally, herbal and dietary supplements, sport and energy boosters, and some other "natural" products are derived from substances often found in

medications that could also have adverse side effects. While some individuals experience no side effects with a particular drug or product, others may be noticeably affected. The FAA regularly reviews FDA and other data to assure that medications found acceptable for aviation duties do not pose an adverse safety risk.

Some of the most commonly used OTC drugs, antihistamines, and decongestants, have the potential to cause noticeable adverse side effects, including drowsiness and cognitive deficits. The symptoms associated with common upper respiratory infections, including the common cold, often suppress a pilot's desire to fly and treating symptoms with a drug that causes adverse side effects only compounds the problem. Particularly, medications containing diphenhydramine (e.g., Benadryl) are known to cause drowsiness and have a prolonged half-life, meaning the drugs stay in one's system for an extended time, which lengthens the time that side effects are present.

Prior to each and every flight, all pilots must do proper physical self-assessment to ensure safety. A great mnemonic is IMSAFE, which stands for Illness, Medication, Stress, Alcohol, Fatigue, and Emotion.

For the medication component of IMSAFE, pilots need to ask themselves, "Am I taking any medicines that might affect my judgment or make me drowsy? For any new medication, OTC or prescribed, you should wait at least 48 hours after the first dose before flying to determine you do not have any adverse side effects that would make it unsafe to operate an aircraft. In addition to medication questions, pilots should also consider the following:

- Do not take any unnecessary or elective medications.
- Make sure you eat regular balanced meals.
- Bring a snack.
- Maintain good hydration - bring plenty of water.
- Ensure adequate sleep the night prior to the flight.
- Stay physically fit.

Alcohol

Alcohol impairs the efficiency of the human body. Studies have shown that consuming alcohol is closely linked to performance deterioration. Pilots must make hundreds of decisions, some time-critical, during the course of a flight. The safe outcome of any flight depends on the ability to make the correct decisions and take the appropriate actions during routine occurrences, as well as abnormal situations. The influence of alcohol drastically reduces the chances of completing a flight without incident. Even in small amounts, alcohol can impair judgment, decrease the sense of responsibility, affect coordination, constrict visual field, diminish memory, reduce reasoning ability, and lower attention span. As little as one ounce of alcohol can decrease the speed and strength of muscular reflexes, lessen the efficiency of eye movements while reading, and increase the frequency at which errors are committed. Impairments in vision and hearing can occur from consuming as little as one drink.

While experiencing a hangover, a pilot is still under the influence of alcohol. Although a pilot may think he or she is functioning normally, motor and mental response impairment are still present. Considerable amounts of alcohol can remain in the body for over 16 hours, so pilots should be cautious about flying too soon after drinking.

Intoxication is determined by the amount of alcohol in the bloodstream. This is usually measured as a percentage by weight in the blood. 14 CFR part 91 requires that blood alcohol level be less than .04 percent and that 8 hours pass between drinking alcohol and piloting an aircraft. A pilot with a blood alcohol level of .04 percent or greater after 8 hours cannot fly until the blood alcohol falls below that amount. Even though blood alcohol may be well below .04 percent, a pilot cannot fly sooner than 8 hours after drinking alcohol. Although the regulations are quite specific, it is a good idea to be more conservative than the regulations.

Vision and Flight

The more a pilot understands about the eyes and how they function, the easier it is to use vision effectively and compensate for potential problems.

Scanning Techniques

To scan effectively, pilots must look from right to left or left to right. They should begin scanning at the greatest distance an object can be perceived (top) and move inward toward the position of the aircraft (bottom). For each stop, an area approximately 30° wide should be scanned. The duration of each stop is based on the degree of detail that is required, but no stop should last longer than 2 to 3 seconds. When moving from one viewing point to the next, pilots should overlap the previous field of view by 10°.

Emergency Procedures

An inflight emergency is usually an unexpected and unforeseen event that can have serious consequences for an unprepared remote pilot. During an emergency, a remote pilot is permitted to deviate from any part of ***14 CFR part 107***[1] to respond to the emergency. When a remote pilot does deviate from a rule due to an emergency, the remote will report the emergency if asked to do so by the FAA (also referred to as “the Administrator”).

Inflight Emergency

A remote pilot is responsible for the safe operation of the small UA at all times. A remote pilot must ensure that the aircraft is in a safe operating condition before the flight, that there is not any hazard to persons or property, and that all required crew members are properly briefed on the operation and emergency procedures.

Before every flight, a remote pilot will conduct a preflight inspection of the aircraft. If any irregularities’ are found in the inspection, they must be corrected before the small UA is operated. Some small UA manufacturers will provide the remote pilot with preflight inspection items. For those small UAs that do not have a manufacturer checklist, the remote should develop a checklist that will provide enough information that the aircraft will be operated in a safe condition.

When a remote pilot does experience an inflight emergency, the pilot may take any action to ensure that there is not a hazard to other people or property. For example, if during a flight, the small UA experiences as battery fire, the remote pilot may need to climb the small UA above 400’ AGL to maneuver to a safe landing area. In this instance, a report will need to be made only if asked to do so by the FAA.

When other crew members are used during a flight, all of those crew members must be briefed on the flight and the planned emergency procedures for the flight. The briefing will be given to any visual observers (VO) that might be used and any non-certificated person who is allowed to manipulate the flight controls of the small UA.

For more information about emergencies, refer to 14 ***CFR Part 107***[2] and ***AC 107-2***[3].

1 URL: https://www.ecfr.gov/cgi-bin/text-idx?SID=4126445f83285fb99751a7af806c3bdf&mc=true&node=pt14.2.107&rgn=div5

2 URL: https://www.ecfr.gov/cgi-bin/text-idx?SID=4126445f83285fb99751a7af806c3bdf&mc=true&node=pt14.2.107&rgn=div5

3 URL: https://www.faa.gov/documentlibrary/media/advisory_circular/ac_107-2.pdf

Sample Questions

Readers may locate the answers to the following questions in Appendix A. The sample questions in this book sometimes refer to figures from the ***FAA-CT-8080-2H Airman Knowledge Testing Supplement***. [1]

6001. A local TV station has hired a remote pilot to operate their small UA to cover breaking news stories. The remote pilot has had multiple near misses with obstacles on the ground and two small UAS accidents. What would be a solution for the news station to improve its operating safety culture?

A. The news station should implement a policy of no more than five crashes/incidents within 6 months.

B. The news station does not need to make any changes; there are times that an accident is unavoidable.

C. The news station should recognize hazardous attitudes and situations and develop standard operating procedures that emphasize safety.

6002. Safety is an important element for a remote pilot to consider prior to operating an unmanned aircraft system. To prevent the final "link" in the accident chain, a remote pilot must consider which methodology?

A. Crew Resource Management.

B. Safety Management System.

C. Risk Management.

6003. When adapting crew resource management (CRM) concepts to the operation of a small UA, CRM must be integrated into

A. the flight portion the only.

B. all phases of operation.

C. the communications only.

6004. Identify the hazardous attitude or characteristic a remote pilot displays while taking risks in order to impress others?

A. Impulsivity.

B. Invulnerability.

C. Macho.

6005. You have been hired as a remote pilot by a local TV news station to film breaking news with a small UA. You expressed a safety concern, and the station manager has instructed you to "fly first, ask questions later." What type of hazardous attitude does this attitude represent?

A. Impulsivity.

B. Invulnerability.

C. Macho.

1 URL: https://www.amazon.com/FAA-CT-8080-2H-Knowledge-Testing-Supplement-Recreational/dp/1674175949/

6006. You are a remote pilot for a co-op energy service provider. You are to use your UA to inspect power lines in the remote area 15 hours away from your home office. After the drive, fatigue impacts your abilities to complete your assignment on time. Fatigue can be recognized

A. easily by an experienced pilot.

B. as being in an impaired state.

C. by an ability to overcome sleep deprivation.

6007. Which is true regarding the presence of alcohol within the human body?

A. A small amount of alcohol increases visual acuity.

B. Consuming an equal amount of water will increase the destruction of alcohol and alleviate a hangover.

C. Judgment and decision-making abilities can be adversely affected by even small amounts of alcohol.

6008. The effective use of all available resources—human, hardware, and information—prior to and during the flight to ensure the successful outcome of the operation is called:

A. Safety Management System.

B. Crew Resource Management.

C. Risk Management.

6009. Rapid or extra deep breathing while using oxygen can cause a condition known as

A. hyperventilation.

B. aerosinusitis.

C. aerotitis.

6010. Which would most likely result in hyperventilation?

A. Emotional tension, anxiety, or fear.

B. The excessive consumption of alcohol.

C. An extremely slow rate of breathing and insufficient oxygen.

6011. A pilot should be able to overcome the symptoms or avoid future occurrences of hyperventilation by

A. closely monitoring the flight instruments to control the airplane.

B. slowing the breathing rate, breathing into a bag, or talking aloud.

C. increasing the breathing rate in order to increase lung ventilation.

6012. What is the antidote when a pilot has a hazardous attitude, such as “Anti-authority”?

A. Rules do not apply in this situation.

B. I know what I am doing.

C. Follow the rules.

6013. What is the antidote when a pilot has a hazardous attitude, such as “Impulsivity”?

A. It could happen to me.

B. Do it quickly to get it over with.

C. Not so fast, think first.

6014. What is the antidote when a pilot has a hazardous attitude, such as “Invulnerability”?

A. It will not happen to me.

B. It can not be that bad.

C. It could happen to me.

6015. What is the antidote when a pilot has a hazardous attitude, such as “Macho”?

A. I can do it.

B. Taking chances is foolish.

C. Nothing will happen.

6016. What is the antidote when a pilot has a hazardous attitude, such as “Resignation”?

A. What is the use?

B. Someone else is responsible.

C. I am not helpless.

6017. Hazardous attitudes occur to every pilot to some degree at some time. What are some of these hazardous attitudes?

A. Poor risk management and lack of stress management.

B. Antiauthority, impulsivity, macho, resignation, and invulnerability.

C. Poor situational awareness, snap judgments, and lack of a decision making process.

6018. In the aeronautical decision making (ADM) process, what is the first step in neutralizing a hazardous attitude?

A. Making a rational judgment.

B. Recognizing hazardous thoughts.

C. Recognizing the invulnerability of the situation.

6019. Risk management, as part of the aeronautical decision making (ADM) process, relies on which features to reduce the risks associated with each flight?

A. Application of stress management and risk element procedures.

B. Situational awareness, problem recognition, and good judgment.

C. The mental process of analyzing all information in a particular situation and making a timely decision on what action to take.

6020. When a stressful situation is encountered in flight, an abnormal increase in the volume of air breathed in and out can cause a condition known as

A. hyperventilation.

B. aerosinusitis.

C. aerotitis.

6021. A pilot experiencing the effects of hyperventilation should be able to restore the proper carbon dioxide level in the body by

A. slowing the breathing rate, breathing into a paper bag, or talking aloud.

B. breathing spontaneously and deeply or gaining mental control of the situation.

C. increasing the breathing rate in order to increase lung ventilation.

6022. A resource you can use to find out detailed information about the effects of alcohol and legal and illegal drugs is

A. NOTAMs.

B. the PHAK (Pilot's Handbook of Aeronautical Knowledge).

C. a Pilot's Operating Handbook.

6023. When using the PAVE checklist, you want to evaluate the risks involving the

A. Passengers, Aviation, enVironment, and External pressures.

B. Pilot, Aircraft, enVironment, and Emergency situations.

C. Pilot, Aircraft, enVironment, and External pressures.

6024. Which category of PAVE can cause pilots to ignore all of the other risk categories?

A. themselves, the pilot.

B. The external pressures of the flight.

C. The risks involving the environment.

6025. You can use the IMSAFE checklist to

A. evaluate your condition as a remote pilot before a flight.

B. preflight your sUAS.

C. check for weather conditions.

6026. Use the acronym IMSAFE before operating your sUAS to

A. make sure you meet all regulatory requirements.

B. preflight your sUAS.

C. make sure you as the remote pilot are fit for the flight.

6027. The CARE attention scan can be used

A. before starting operations to evaluate the risks.

B. during operations to maintain situational awareness.

C. at the end of operations to debrief the crew.

6028. The CARE attention scan helps ensure that during operations you

A. always have an alternative action available.

B. have all required documentation available.

C. have a positive attitude and hope for the best when things go wrong.

6029. After having dinner and wine, your client asks you to go outside to demonstrate the small UAs capabilities. You must

A. pass a self-administered sobriety test before operating a small UA.

B. not operate a small UA within 8 hours of consuming any alcoholic beverage.

C. ensure that your visual observer has not consumed any alcoholic beverage in the previous 12 hours.

6030. When a remote pilot-in-command and a visual observer define their roles and responsibilities prior to and during the operation of a small UA, this is a good use of

A. Crew Resource Management.

B. Authoritarian Resource Management.

C. Single Pilot Resource Management.

Appendix A

Readers may locate the answers to the following questions in Appendix A. The sample questions in this book sometimes refer to figures from the ***FAA-CT-8080-2H Airman Knowledge Testing Supplement***. [1]

Regulations

1001. Which technique should a remote pilot use to scan for traffic? A remote pilot should

A. systematically focus on different segments of the sky for short intervals.

1002. Under what condition would a small UA not have to be registered before it is operated in the United States?

A. When the aircraft weighs less than .55 pounds on takeoff, including everything that is on-board or attached to the aircraft.

1003. According to 14 CFR part 48, when must a person register a small UA with the Federal Aviation Administration?

A. All civilian small UAs weighing greater than .55 pounds must be registered regardless of its intended use.

1004. According to 14 CFR part 48, when would a small UA owner not be permitted to register it?

A. The owner is less than 13 years of age.

1005. According to 14 CFR part 107, what is required to operate a small UA within 30 minutes after official sunset?

A. Use of anti-collision lights.

1006. To avoid a near midair collision (NMAC) with a manned airplane, you estimate that your small UA climbed to an altitude greater than 6400 feet AGL. To whom must you submit a written report of the deviation?

C. The Federal Aviation Administration, if requested.

1007. Which of the following individuals may process an application for a part 107 remote pilot certificate with an sUAS rating?

B. Designated Pilot Examiner.

1008. After receiving a part 107 remote pilot certificate with an sUAS rating, how often must you satisfy recurrent training requirements?

C. Every 24 months.

1009. According to 14 CFR part 107, an sUAS is an unmanned aircraft system weighing:

B. Less than 55 lbs.

1 URL: https://www.amazon.com/FAA-CT-8080-2H-Knowledge-Testing-Supplement-Recreational/dp/1674175949/

1010. Unmanned aircraft means an aircraft operated:

B. Without the possibility of direct human intervention from within or on the aircraft.

1011. Which of the following types of operations are excluded from the requirements in part 107?

A. Model aircraft for hobby use.

1012. Which of the following operations would be regulated by 14 CFR 107?

A. Operating your sUAS for an imagery company.

1013. A person without a part 107 remote pilot certificate may operate an sUAS for commercial operations:

A. Under the direct supervision of a Remote PIC.

1014. A person whose sole task is watching the sUAS to report hazards to the rest of the crew is called:

C. Visual observer.

1015. Before each flight, the Remote PIC must ensure that:

C. Objects carried on the sUAS are secure.

1016. In accordance with 14 CFR part 107, you may operate an sUAS from a moving vehicle when no property is carried for compensation or hire:

A. Over a sparsely populated area.

1017. In accordance with 14 CFR part 107, except when within a 400' radius of a structure, at what maximum altitude can you operate sUAS?

A. 400 feet AGL.

1018. The FAA may approve your application for a waiver of provisions in part 107 only when it has been determined that the proposed operation:

C. Can be safely conducted under the terms of that certificate of waiver.

1019. When requesting a waiver, the required documents should be presented to the FAA at least how many days prior to the planned operation?

A. 90 days.

1020. While operating a small unmanned aircraft system (sUAS), you experience a flyaway, and several people suffer injuries. Which of the following injuries requires reporting to the FAA?

A. An injury requiring an overnight hospital stay.

1021. Within how many days must an sUAS accident be reported to the FAA?

A. 10 days.

1022. While operating your sUAS to do aerial photography, you have a flyaway that causes $700 worth of property damage. Within how many days must you report this accident?

B. 10 days.

1023. While operating under Part 107, you crash your sUAS into parking lot lighting, which would cost $300 to repair or $750 to replace. Within how many days must you report this accident?

C. You are not required to report this accident.

1024. Under Part 107, you must cease operating an sUAS at

B. the end of evening civil twilight.

1025. You are inspecting a tower that has a top of 1200 feet AGL. What is the maximum altitude you can fly when operating within 50 feet of this structure?

C. 1600 feet AGL.

1026. You are approaching an obstacle that is 800 feet above the ground. Under Part 107, can you legally fly over this obstacle?

B. Yes, if you are within 400 feet of the obstacle and fly at or below 1200 feet AGL.

1027. If a certificated pilot changes permanent mailing address and fails to notify the FAA Airmen Certification Branch of the new address, the pilot is entitled to exercise the privileges of the pilot certificate for a period of only

A. 30 days after the date of the move.

1028. What effect does haze have on the ability to see traffic or terrain features during the flight?

C. All traffic or terrain features appear to be farther away than their actual distance.

1029. The most effective method of scanning for other aircraft for collision avoidance during daylight hours is to use

B. a series of short regularly spaced eye movements to search each 10-degree sector.

1030. Most midair collision accidents occur during

B. clear days.

1031. If you bring an sUAS that was registered in another country to operate in the U.S. under Part 107 you must

C. obtain a Foreign Aircraft Permit.

1032. A flight control failure causes your UAS to collide with the ground without damage to any other property. A report

A. must be made immediately to the NTSB.

1033. A public unmanned aircraft system (UAS)

B. is a UAS owned or operated by a federal, state, or local government agency.

1034. A public UAS

C. must be operated in accordance with Part 107 unless a Certificate of Authorization (COA) is obtained.

1035. To avoid a collision with an unexpectedly large flock of birds, you climb your UAV to 600 feet AGL. A written report

C. must be submitted to the FAA if requested.

1036. In the event of a near midair collision with an airplane, the UAS PIC

A. is urged to make a report to ATC.

1037. A small UA causes an accident, and your crew member loses consciousness. When do you report the accident?

C. Within 10 days of the accident.

1038. A small UA must be operated in a manner which

A. does not endanger the life or property of another.

1039. You plan to release golf balls from your small UA at an altitude of 100 feet AGL. You must ensure the objects being dropped will

A. not create an undue hazard to persons or property.

1040. During a flight of your small UA, you observe a hot air balloon entering the area. You should

A. yield the right-of-way to the hot air balloon.

1041. According to 14 CFR part 107, what is the maximum ground speed for a small UA?

A. 87 knots.

1042. (**Refer to Figure 78**.) You have been contracted to inspect towers located approximately 4NM southwest of the Sioux Gateway (SUX) airport operating an unmanned aircraft. What is the maximum altitude above ground level (AGL) that you are authorized to operate over the top of the towers?

C. 802 feet AGL.

1043. Upon request by the FAA, the remote pilot-in-command must provide

B. a remote pilot certificate with a small UAS rating.

1044. The refusal of a remote PIC to submit to a blood-alcohol test when requested by a law enforcement officer

A. is grounds for suspension or revocation of their remote pilot certificate.

1045. (**Refer to Figure 23**, area 4) What is the required flight visibility for a remote pilot operating an unmanned aircraft near the Plantation Airport (JYL)?

C. 3 statute miles.

Aircraft Performance

Readers may locate the answers to the following questions in Appendix A. The sample questions in this book sometimes refer to figures from the ***FAA-CT-8080-2H Airman Knowledge Testing Supplement***. [2]

2001. What effect does high-density altitude have on the efficiency of a UA propeller?

B. Propeller efficiency is decreased.

2002. To ensure that the unmanned aircraft center of gravity (CG) limits are not exceeded, follow the aircraft loading instructions specified in the

A. Pilot's Operating Handbook or UAS Flight Manual.

2003. What could be a consequence of operating a small unmanned aircraft above its maximum allowable weight?

A. Shorter endurance.

2004. According to 14 CFR part 107, who is responsible for determining the performance of a small unmanned aircraft?

A. Remote pilot-in-command.

2005. When operating an unmanned airplane, the remote pilot should consider that the load factor on the wings may be increased any time

B. the airplane is subjected to maneuvers other than straight-and-level flight.

2006. A stall occurs when the smooth airflow over the unmanned airplane's wing is disrupted, and the lift degenerates rapidly. This is caused when the wing

C. exceeds its critical angle of attack.

2007. (**Refer to Figure 2**.) If an unmanned airplane weighs 33 pounds, what approximate weight would the airplane structure be required to support during a 30° banked turn while maintaining altitude?

C. 38 pounds.

2008. How would high-density altitude affect the performance of a small unmanned aircraft?

B. Decreased performance.

2009. Operating outside of the weight and balance limits of an unmanned aircraft

A. can result in loss of control of the aircraft.

2010. (**Refer to Figure 2**.) If an unmanned aircraft weighs 20 pounds, what approximate weight would the aircraft structure be required to support during a 60° banked turn while maintaining altitude?

C. 40 pounds.

2 URL: https://www.amazon.com/FAA-CT-8080-2H-Knowledge-Testing-Supplement-Recreational/dp/1674175949/

2011. An unmanned aircraft has been loaded in such a manner that the CG is located aft of the aft CG limit. One undesirable flight characteristic a remote pilot might experience with this aircraft would be

B. difficulty in recovering from a stalled condition.

2012. (**Refer to Figure 2**.) If an unmanned aircraft weighs 45 pounds, what approximate weight would the aircraft structure be required to support during a 45° banked turn while maintaining altitude?

B. 63 pounds.

2013. The four forces acting on an airplane in flight are

A. lift, weight, thrust, and drag.

2014. When are the four forces that act on an airplane in equilibrium?

A. During unaccelerated flight.

2015. (**Refer to Figure 1**.) The acute angle A is the angle of

B. attack.

2016. The term "angle of attack" is defined as the angle between the

A. chord line of the wing and the relative wind.

2017. What is the relationship between lift, drag, thrust, and weight when the airplane is in straight-and-level flight?

A. Lift equals weight, and thrust equals drag.

2018. An airplane said to be inherently stable will

B. requires less effort to control.

2019. The amount of excess load that can be imposed on the wing of an airplane depends upon the

B. speed of the airplane.

2020. Which basic flight maneuver increases the load factor on an airplane as compared to straight-and-level flight?

B. Turns.

2021. What effect does high-density altitude, as compared to low-density altitude, have on propeller efficiency and why?

B. Efficiency is reduced because the propeller exerts less force at high-density altitudes than at low-density altitudes.

2022. What is density altitude?

B. The pressure altitude corrected for non-standard temperature.

2023. If the outside air temperature (OAT) at a given altitude is warmer than standard, the density altitude is

C. higher than pressure altitude.

2024. Which combination of atmospheric conditions will reduce aircraft takeoff and climb performance?

C. High temperature, high relative humidity, and high-density altitude.

2025. What effect does high-density altitude have on aircraft performance?

B. It reduces climb performance.

2026. What effect, if any, does high humidity have on aircraft performance?

B. It decreases performance.

2027. The angle of attack at which an airplane wing stalls will

C. remain the same regardless of gross weight.

2028. Under which condition will pressure altitude be equal to true altitude?

B. When standard atmospheric conditions exist.

2029. Under what condition is pressure altitude and density altitude the same value?

C. At standard temperature.

2030. Which factor would tend to increase the density altitude at a given airport?

B. An increase in ambient temperature.

2031. Which statement relates to Bernoulli's principle?

C. Air traveling faster over the curved upper surface of an airfoil causes lower pressure on the top surface.

2032. The angle between the chord line of an airfoil and the relative wind is known as the angle of

B. attack.

2033. Changes in the center of pressure of a wing affect the aircraft's

C. aerodynamic balance and controllability.

2034. At what bank angle for a turn does the additional force on the wings become significant?

C. 45 degrees.

The National Airspace System

Readers may locate the answers to the following questions in Appendix A. The sample questions in this book sometimes refer to figures from the ***FAA-CT-8080-2H Airman Knowledge Testing Supplement***. [3]

3001. (**Refer to Figure 20**, area 2.) Why would the small flag at Lake Drummond of the sectional chart be important to a remote pilot?

A. This is a VFR checkpoint for manned aircraft, and a higher volume of air traffic should be expected there.

3002. What is the maximum allowable groundspeed for a UAV beneath Class B airspace?

A. 87 knots.

3003. (**Refer to Figure 20**, area 3.) With ATC authorization, you are operating your small unmanned aircraft approximately 4 SM southeast of Elizabeth City Regional Airport (ECG). What hazard is indicated to be in that area?

C. Unmarked balloon on a cable up to 3,008 feet MSL.

3004. (**Refer to Figure 78**.) You have been hired to use your small UAS to inspect the railroad tracks from Blencoe (SE of Sioux City) to Onawa. Will ATC authorization be required?

B. No, your entire flight is in Class G airspace.

3005. (**Refer to Figure 20**, area 3.) Determine the approximate latitude and longitude of Currituck County Airport.

A. 36°24'N - 76°01'W.

3006. (**Refer to Figure 26**, area 3.) When flying over Arrowwood National Wildlife Refuge, a pilot should fly no lower than

A. 2,000 feet AGL.

3007. With certain exceptions, Class E airspace extends upward from either 700 feet or 1,200 feet AGL to, but does not include,

C. 18,000 feet MSL.

3008. (**Refer to Figure 25**, area 4.) The airspace directly overlying Fort Worth Meacham is

C. Class D airspace to 3,200 feet MSL.

3009. (**Refer to Figure 24**, area 3.) For information about the parachute operations at Tri-County Airport, refer to

B. Chart Supplements U.S.

3 URL: https://www.amazon.com/FAA-CT-8080-2H-Knowledge-Testing-Supplement-Recreational/dp/1674175949/

3010. (**Refer to Figure 21**.) The terrain elevation of the light tan area between Minot (area 1) and Audubon Lake (area 2) varies from

B. 2,000 feet to 2,500 feet MSL.

3011. (**Refer to Figure 22**, area 3.) Determine the approximate latitude and longitude of Shoshone County Airport.

B. 47°33'N - 116°11'W.

3012. (**Refer to Figure 78**.) What class of airspace is associated with SIOUX GATEWAY/COL DAY (SUX) Airport?

C. Class D airspace.

3013. Information concerning parachute jumping sites may be found in the

B. Chart Supplement.

3014. Pilots flying over a national wildlife refuge are requested to fly no lower than

B. 2,000 feet AGL.

3015. (**Refer to Figure 20**, area 2.) The elevation of the Chesapeake Regional Airport is

A. 19 feet.

3016. The width of a Federal Airway from either side of the centerline is

A. 4 nautical miles.

3017. (**Refer to Figure 59**, area 2.) The chart shows a gray line with "VR1667, VR1617, VR1638, and VR1668." Could this area present a hazard to the operations of a small UA?

B. Yes, this is a Military Training Route from the surface to 1,500 feet AGL.

3018. (**Refer to Figure 26**, area 2.) What is the approximate latitude and longitude of Cooperstown Airport?

A. 47°25'N - 98°06'W.

3019. The purpose of Military Training Routes charted as VFR Military Training Routes (VR) and IFR Military Training Routes (IR) on sectional charts, is to ensure the greatest practical level of safety for all flight operations and to allow the military to conduct

A. low altitude, high-speed training.

3020. According to 14 CFR part 107 the remote pilot in command (PIC) of a small unmanned aircraft planning to operate within Class C airspace

C. is required to receive ATC authorization.

3021. (**Refer to Figure 26**, area 1.) Identify the airspace over Tomlinson Airport (8J7).

A. Class G airspace - surface up to but not including 1,200 feet AGL, Class E airspace - 1,200 feet AGL up to but not including 18,000 feet MSL.

3022. (**Refer to Figure 75**, area 6.) During preflight planning, you plan to operate in R-2305. Where would you find additional information regarding this airspace?

C. In the Special Use Airspace area of the chart.

3023. (**Refer to Figure 21**, area 3.) Which airport is located at approximately 47°21'N latitude and 101°01'W longitude?

C. Washburn.

3024. Flight through a restricted area should not be accomplished unless the remote pilot has

B. received prior authorization from the controlling agency.

3025. (**Refer to Figure 26**.) What does the line of latitude at area 4 measure?

B. The degrees of latitude north and south from the equator.

3026. Responsibility for collision avoidance in an alert area rests with

B. all pilots.

3027. (**Refer to Figure 20** area 4.) What hazards to aircraft may exist in restricted areas such as R-5302B?

A. Unusual, often invisible, hazards such as aerial gunnery or guided missiles.

3028. The vertical limit of Class C airspace above the primary airport is normally

C. 4,000 feet AGL.

3029. (**Refer to Figure 25**, area 4.) The floor of Class B airspace overlying Hicks Airport (T67) north-northwest of Fort Worth Meacham Field is

C. 4,000 feet MSL.

3030. Under which conditions may a pilot fly under VFR within 60 nautical miles of the DCA VOR in Washington, D.C.?

C. As long as the pilot has completed special awareness training and remains clear of the SFRA.

3031. (**Refer to Figure 20**, area 1.) The NALF Fentress (NFE) Airport is in what type of airspace?

B. Class E.

3032. (**Refer to Figure 20**, area 5.) How would a remote PIC "CHECK NOTAMS" as noted in the CAUTION box regarding the unmarked balloon?

C. By obtaining a briefing via an online source such as 1800WXBrief.com.

3033. (**Refer to Figure 26**, area 4.) You have been hired to inspect the tower under construction at 46.9N and 98.6W, near Jamestown Regional (JMS). What must you receive prior to flying your unmanned aircraft in this area?

B. Authorization from ATC.

3034. (**Refer to Figure 25**, area 3.) The floor of Class B airspace at Dallas Executive (RBD) is

C. 3,100 feet MSL.

3035. (**Refer to Figure 21**, area 1.) After receiving authorization from ATC to operate a small UA near Minot International airport (MOT) while the control tower is operational, which radio communication frequency could be used to monitor manned aircraft and ATC communications?

C. CT-118.2.

3036. What action should a remote pilot take when operating in a Military Operations Area (MOA)?

C. Exercise extreme caution when military activity is being conducted.

3037. (**Refer to Figure 20**, area 5.) The CAUTION box denotes what hazard to aircraft?

A. Unmarked balloon on a cable to 3,008 feet MSL.

3038. Unless otherwise specified, Federal Airways include that Class E airspace extending upward from

B. 1,200 feet above the surface up to and including 17,999 feet MSL.

3039. (**Refer to Figure 23**.) The flag symbols at Statesboro Bulloch County Airport, Claxton-Evans County Airport and Ridgeland Airport are

C. visual checkpoints to identify the position for initial call-up prior to entering Savannah Class C airspace.

3040. (**Refer to Figure 23**, area 3.) What is the floor of the Savannah Class C airspace at the shelf area (outer circle)?

B. 1,300 feet MSL.

3041. A blue segmented circle on a Sectional Chart depicts which class airspace?

C. Class D.

3042. Which is true concerning the blue and magenta colors used to depict airports on Sectional Aeronautical Charts?

C. Airports with control towers underlying Class B, C, D, and E airspace are shown in blue.

3043. (**Refer to Figure 25**, area 7.) The airspace overlying McKinney (TKI) is controlled from the surface to

A. 2,900 feet MSL.

3044. The lateral dimensions of Class D airspace are based on

C. the instrument procedures for which the controlled airspace is established.

3045. (**Refer to Figure 25**, area 2.) The control tower frequency for Addison Airport is

B. 126.0 MHz.

3046. (**Refer to Figure 20**, area 4.) A small UA is being launched 2 NM northeast of the town of Hertford. What is the height of the highest obstacle?

C. 500 feet AGL.

3047. (**Refer to Figure 20**, area 2.) The flag symbol at Lake Drummond represents a

C. visual checkpoint used to identify the position for an initial callup to Norfolk Approach Control.

3048. The VFR pilot flying in Class G airspace

C. has reduced cloud and visibility restrictions because it's unlikely that IFR traffic will be operating in Class G airspace.

3049. According to 14 CFR part 107, how may a remote pilot operate an unmanned aircraft in Class C airspace?

A. The remote pilot must have prior authorization from the Air Traffic Control (ATC) facility having jurisdiction over that airspace.

3050. (**Refer to Figure 23**, area 3.) The top of the group obstruction approximately 11 nautical miles from the Savannah VORTAC on the 007° radial is

B. 454 feet MSL.

3051. (**Refer to Figure 21**, area 2.) Which airport is located at approximately 47°34'30"N latitude and 100°44'00"W longitude?

B. Makeeff.

3052. Which statement about longitude and latitude is true?

B. Lines of longitude cross the Equator at right angles.

3053. (**Refer to Figure 25**, area 2.) The floor of Class B airspace at Air Park-Dallas Airport is

B. 3,000 feet MSL.

3054. You know when looking at a chart that the floor of Class E airspace is 700 feet AGL when it's within

B. the fuzzy side of the magenta vignette.

3055. (**Refer to Figure 21**.) What airport is located approximately 47 (degrees) 40 (minutes) N latitude and 101 (degrees) 26 (minutes) W longitude?

C. Garrison Airport.

3056. The normal radius of the procedural Outer Area of Class C airspace is normally

C. 20 nautical miles.

3057. (**Refer to Figure 24**, area 1.) For information about the parachute jumping at Caddo Mills Airport, refer to

B. the Chart Supplement.

3058. (**Refer to Figure 26**, area 5.) The airspace overlying and within 5 miles of Barnes County Airport is

C. Class G airspace from the surface to 700 feet AGL.

3059. One of the purposes for issuing a Temporary Flight restriction (TFR) is to

B. protect public figures.

3060. (**Refer to Figure 24**, area 6.) What type of airport is Card Airport?

C. Private non-towered.

Airport Operations

Readers may locate the answers to the following questions in Appendix A. The sample questions in this book sometimes refer to figures from the ***FAA-CT-8080-2H Airman Knowledge Testing Supplement***. [4]

4001. The most comprehensive information on a given airport is provided by

A. the Chart Supplements U.S. (formerly Airport Facility Directory).

4002. (**Refer to Figure 50**.) The segmented circle indicates that a landing on Runway 27 will be with a

A. right-quartering headwind.

4003. (**Refer to Figure 25**, area 3.) If Dallas Executive (RDB) Tower is not in operation, which frequency should be used as a Common Traffic Advisory Frequency (CTAF) to monitor airport traffic?

A. 127.25 MHz.

4004. (**Refer to Figure 22**, area 2.) At Coeur D'Alene, which frequency should be used as a Common Traffic Advisory Frequency (CTAF) to monitor airport traffic?

B. 135.075 MHz.

4005. Automatic Terminal Information Service (ATIS) is the continuous broadcast of recorded information concerning

C. non-control information in selected high activity terminal areas.

4006. (**Refer to Figure 52**.) Traffic patterns in effect at Lincoln Municipal are

B. to the left on Runway 17 and Runway 36; to the right on Runway 18 and Runway 35.

4007. An ATC radar facility issues the following advisory to a pilot flying on a heading of 090°:

"TRAFFIC 3 O'CLOCK, 2 MILES, WESTBOUND..."

Where should the pilot look for this traffic?

B. South.

4008. When an air traffic controller issues radar traffic information in relation to the 12-hour clock, the reference the controller uses is the aircraft's

B. ground track.

4009. (**Refer to Figure 48**.) What is the difference between area A and area E on the airport depicted?

A. "A" may be used for taxi and takeoff; "E" may be used only as an overrun.

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4 URL: https://www.amazon.com/FAA-CT-8080-2H-Knowledge-Testing-Supplement-Recreational/dp/1674175949/

4010. An ATC radar facility issues the following advisory to a pilot flying on a heading of 360°:

"TRAFFIC 10 O'CLOCK, 2 MILES, SOUTHBOUND..."

Where should the pilot look for this traffic?

A. Northwest.

4011. The numbers 8 and 26 on the approach ends of the runway indicate that the runway is orientated approximately

C. 080° and 260° magnetic.

4012. What does the outbound destination sign identify?

C. Identifies direction to take-off runways.

4013. "Runway hold position" markings on the taxiway

A. identifies where aircraft hold short of the runway.

4014. When a control tower, located on an airport within Class D airspace, ceases operation for the day, what happens to the airspace designation?

C. The airspace reverts to Class E or a combination of Class E and G airspace during the hours the tower is not in operation.

4015. A military air station can be identified by a rotating beacon that emits

B. two quick, white flashes between green flashes.

4016. (**Refer to Figure 50**.) The segmented circle indicates that the airport traffic is

A. left-hand for Runway 36 and right-hand for Runway 18.

4017. (**Refer to Figure 27**.) An aircraft departs an airport in the central standard time zone at 0930 CST for a 2-hour flight to an airport located in the mountain standard time zone. The landing should be at what time?

B. 1030 MST.

4018. When flying HAWK N666CB, the proper phraseology for initial contact with McAlester AFSS is

A. "MC ALESTER RADIO, HAWK SIX SIX SIX CHARLIE BRAVO, RECEIVING ARDMORE VORTAC, OVER."

OVER."

4019. The "yellow demarcation bar" marking indicates

A. runway with a displaced threshold that precedes the runway.

4020. An ATC radar facility issues the following advisory to a pilot flying north in a calm wind:

"TRAFFIC 9 O'CLOCK, 2 MILES, SOUTHBOUND..."

Where should the pilot look for this traffic?

C. West.

4021. (**Refer to Figure 26**, area 5.) What is the CTAF/UNICOM frequency at Barnes County Airport?

B. 122.8 MHz.

4022. As a standard operating practice, all inbound traffic to an airport without a control tower should continuously monitor the appropriate facility from a distance of

C. 10 miles.

4023. An ATC radar facility issues the following advisory to a pilot during a local flight:

"TRAFFIC 2 O'CLOCK, 5 MILES, NORTHBOUND..."

Where should the pilot look for this traffic?

C. Between directly ahead and 90° to the right.

4024. (**Refer to Figure 64**.) Which marking indicates a vehicle lane?

B. C.

4025. The "runway hold position" sign denotes

B. an entrance to runway from a taxiway.

4026. Airspace at an airport with a part-time control tower is classified as Class D airspace only

B. when the associated control tower is in operation.

4027. You are conducting sUAS operations just north of an airport when ATC instructs you to remain clear of final for runway 9. You

B. can continue your operations.

4028. (**Refer to Figure 65**.) The red symbol at sign D would most likely be found

C. at an intersection where a roadway may be mistaken as a taxiway.

4029. When approaching taxiway holding lines from the side with the continuous lines, the pilot

B. should not cross the lines without ATC clearance.

4030. (**Refer to Figure 48**.) Area C on the airport depicted is classified as a

C. closed runway.

4031. (**Refer to Figure 21**, area 2.) The CTAF/MULTICOM frequency for Garrison Airport is

B. 122.9 MHz.

4032. The numbers 9 and 27 on a runway indicate that the runway is oriented approximately

C. 090° and 270° magnetic.

4033. (**Refer to Figure 48**.) According to the airport diagram, which statement is true?

B. Takeoffs may be started at position A on Runway 12, and the landing portion of this runway begins at position B.

4034. The “taxiway ending” marker

A. indicates the taxiway does not continue.

Weather

Readers may locate the answers to the following questions in Appendix A. The sample questions in this book sometimes refer to figures from the ***FAA-CT-8080-2H Airman Knowledge Testing Supplement***. [5]

5001. If an unstable air mass is forced upward, what type of clouds can be expected?

C. Clouds with considerable vertical development and associated turbulence.

5002. The conditions necessary for the formation of cumulonimbus clouds are a lifting action and

B. unstable, moist air.

5003. If the temperature/dewpoint spread is small and decreasing, and the temperature is 62 °F, what type of weather is most likely to develop?

C. Fog or low clouds.

5004. (**Refer to Figure 15**.) In the TAF for KMEM, what does "SHRA" stand for?

A. Rain showers.

5005. What are the characteristics of a moist, unstable air mass?

A. Cumuliform clouds and showery precipitation.

5006. While operating around buildings, the Remote Pilot in Command should be aware of the creation of wind gusts that:

A. Change rapidly in direction and speed, causing turbulence.

5007. The amount of water vapor which air can hold depends on the

B. air temperature.

5008. Possible mountain wave turbulence could be anticipated when winds of 40 knots or greater blow

A. across a mountain ridge and the air is stable.

5009. (**Refer to Figure 12**.) What are the wind conditions at Wink, Texas (KINK)?

B. 110° at 12 knots, gusts 18 knots.

5010. For aviation purposes, the ceiling is defined as the height above the Earth's surface of the

B. lowest broken or overcast layer or vertical visibility into an obscuration.

5011. An almond or lens-shaped cloud which appears stationary, but which may contain winds of 50 knots or more, is referred to as

C. a lenticular cloud.

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5 URL: https://www.amazon.com/FAA-CT-8080-2H-Knowledge-Testing-Supplement-Recreational/dp/1674175949/

5012. What would decrease the stability of an air mass?

A. Warming from below.

5013. What cloud types would indicate convective turbulence?

C. Towering cumulus clouds.

5014. What types of fog depend upon the wind in order to exist?

C. Advection fog and upslope fog.

5015. At approximately what altitude above the surface would the pilot expect the base of cumuliform clouds if the surface air temperature is 82 °F and the dewpoint is 38 °F?

B. 10,000 feet AGL.

5016. One weather phenomenon which will always occur when flying across a front is a change in the

A. wind direction.

5017. If there is thunderstorm activity in the vicinity of an airport at which you plan to land, which hazardous atmospheric phenomenon might be expected on the landing approach?

B. Wind-shear turbulence.

5018. What are the standard temperature and pressure values for sea level?

A. 15 °C and 29.92 inches Hg.

5019. Clouds are divided into four families according to their

B. height range.

5020. Thunderstorms reach their greatest intensity during the

A. mature stage.

5021. A stable air mass is most likely to have which characteristic?

C. Smooth air.

5022. Which weather conditions should be expected beneath a low-level temperature inversion layer when the relative humidity is high?

A. Smooth air, poor visibility, fog, haze, or low clouds.

5023. What conditions are necessary for the formation of thunderstorms?

A. High humidity, lifting force, and unstable conditions.

5024. What feature is normally associated with the cumulus stage of a thunderstorm?

B. Continuous updraft.

5025. What are the characteristics of unstable air?

A. Turbulence and good surface visibility.

5026. What is a characteristic of stable air?

A. Stratiform clouds.

5027. Where does wind shear occur?

C. At all altitudes, in all directions.

5028. What clouds have the greatest turbulence?

B. Cumulonimbus.

5029. (**Refer to Figure 12**.) The wind direction and velocity at KJFK is from

A. 180° true at 4 knots.

5030. A pilot can expect a wind-shear zone in a temperature inversion whenever the wind speed at 2,000 to 4,000 feet above the surface is at least

C. 25 knots.

5031. A non-frontal, narrow band of active thunderstorms that often develop ahead of a cold front is known as a

B. squall line.

5032. The presence of ice pellets at the surface is evidence that there

C. is a temperature inversion with freezing rain at a higher altitude.

5033. One of the most easily recognized discontinuities across a front is

A. a change in temperature.

5034. Clouds, fog, or dew will always form when

A. water vapor condenses.

5035. One in-flight condition necessary for structural icing to form is

C. visible moisture.

5036. Low-level turbulence can occur, and icing can become hazardous in which type of fog?

C. Steam fog.

5037. What are the characteristics of stable air?

B. Poor visibility and steady precipitation.

5038. You have received an outlook briefing from flight service through 1800wxbrief.com. The briefing indicates you can expect a low-level temperature inversion with high relative humidity. What weather conditions would you expect when operating within the inversion?

A. Smooth air, poor visibility, fog, haze, or low clouds.

5039. What situation is most conducive to the formation of radiation fog?

A. Warm, moist air over low, flatland areas on clear, calm nights.

5040. During the life cycle of a thunderstorm, which stage is characterized predominately by downdrafts?

B. Dissipating.

5041. An air mass moving inland from the coast in winter is likely to result in

B. fog.

5042. Every physical process of weather is accompanied by or is the result of, a

C. heat exchange.

5043. The wind at 5,000 feet AGL is southwesterly while the surface wind is southerly. This difference in direction is primarily due to

B. friction between the wind and the surface.

5044. Steady precipitation preceding a front is an indication of

C. stratiform clouds with little or no turbulence.

5045. The boundary between two different air masses is referred to as a

C. front.

Risk Management

Readers may locate the answers to the following questions in Appendix A. The sample questions in this book sometimes refer to figures from the ***FAA-CT-8080-2H Airman Knowledge Testing Supplement***. [6]

6001. A local TV station has hired a remote pilot to operate their small UA to cover breaking news stories. The remote pilot has had multiple near misses with obstacles on the ground and two small UAS accidents. What would be a solution for the news station to improve its operating safety culture?

C. The news station should recognize hazardous attitudes and situations and develop standard operating procedures that emphasize safety.

6002. Safety is an important element for a remote pilot to consider prior to operating an unmanned aircraft system. To prevent the final "link" in the accident chain, a remote pilot must consider which methodology?

C. Risk Management.

6003. When adapting crew resource management (CRM) concepts to the operation of a small UA, CRM must be integrated into

B. all phases of operation.

6004. Identify the hazardous attitude or characteristic a remote pilot displays while taking risks in order to impress others?

C. Macho.

6005. You have been hired as a remote pilot by a local TV news station to film breaking news with a small UA. You expressed a safety concern, and the station manager has instructed you to "fly first, ask questions later." What type of hazardous attitude does this attitude represent?

A. Impulsivity.

6006. You are a remote pilot for a co-op energy service provider. You are to use your UA to inspect power lines in the remote area 15 hours away from your home office. After the drive, fatigue impacts your abilities to complete your assignment on time. Fatigue can be recognized

B. as being in an impaired state.

6007. Which is true regarding the presence of alcohol within the human body?

C. Judgment and decision-making abilities can be adversely affected by even small amounts of alcohol.

6008. The effective use of all available resources—human, hardware, and information—prior to and during the flight to ensure the successful outcome of the operation is called:

B. Crew Resource Management.

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6 URL: https://www.amazon.com/FAA-CT-8080-2H-Knowledge-Testing-Supplement-Recreational/dp/1674175949/

6009. Rapid or extra deep breathing while using oxygen can cause a condition known as

A. hyperventilation.

6010. Which would most likely result in hyperventilation?

A. Emotional tension, anxiety, or fear.

6011. A pilot should be able to overcome the symptoms or avoid future occurrences of hyperventilation by

B. slowing the breathing rate, breathing into a bag, or talking aloud.

6012. What is the antidote when a pilot has a hazardous attitude, such as “Anti-authority”?

C. Follow the rules.

6013. What is the antidote when a pilot has a hazardous attitude, such as “Impulsivity”?

C. Not so fast, think first.

6014. What is the antidote when a pilot has a hazardous attitude, such as “Invulnerability”?

C. It could happen to me.

6015. What is the antidote when a pilot has a hazardous attitude, such as “Macho”?

B. Taking chances is foolish.

6016. What is the antidote when a pilot has a hazardous attitude, such as “Resignation”?

C. I am not helpless.

6017. Hazardous attitudes occur to every pilot to some degree at some time. What are some of these hazardous attitudes?

B. Antiauthority, impulsivity, macho, resignation, and invulnerability.

6018. In the aeronautical decision making (ADM) process, what is the first step in neutralizing a hazardous attitude?

B. Recognizing hazardous thoughts.

6019. Risk management, as part of the aeronautical decision making (ADM) process, relies on which features to reduce the risks associated with each flight?

B. Situational awareness, problem recognition, and good judgment.

take.

6020. When a stressful situation is encountered in flight, an abnormal increase in the volume of air breathed in and out can cause a condition known as

A. hyperventilation.

6021. A pilot experiencing the effects of hyperventilation should be able to restore the proper carbon dioxide level in the body by

A. slowing the breathing rate, breathing into a paper bag, or talking aloud.

6022. A resource you can use to find out detailed information about the effects of alcohol and legal and illegal drugs is

B. the PHAK (Pilot's Handbook of Aeronautical Knowledge).

6023. When using the PAVE checklist, you want to evaluate the risks involving the

C. Pilot, Aircraft, enVironment, and External pressures.

6024. Which category of PAVE can cause pilots to ignore all of the other risk categories?

B. The external pressures of the flight.

6025. You can use the IMSAFE checklist to

A. evaluate your condition as a remote pilot before a flight.

6026. Use the acronym IMSAFE before operating your sUAS to

C. make sure you as the remote pilot are fit for the flight.

6027. The CARE attention scan can be used

B. during operations to maintain situational awareness.

6028. The CARE attention scan helps ensure that during operations you

A. always have an alternative action available.

6029. After having dinner and wine, your client asks you to go outside to demonstrate the small UAs capabilities. You must

B. not operate a small UA within 8 hours of consuming any alcoholic beverage.

6030. When a remote pilot-in-command and a visual observer define their roles and responsibilities prior to and during the operation of a small UA, this is a good use of

A. Crew Resource Management.

Appendix B: Abbreviations and Acronyms

The following abbreviations and acronyms are used in this study guide.

Abb./Acronym	Definition
14 CFR	Title 14 of the Code of Federal Regulations
AC	Advisory Circular
ACS	Airman Certification Standards
ADDS	Aviation Digital Data Services
ADIZ	Air Defense Identification Zone
ADM	Aeronautical Decision-Making
AFM	Airplane Flight Manual
AFS	Flight Standards Service
AGL	Above Ground Level
AIRMET	Airman's Meteorological Information
AOA	Angle of Attack
ATC	Air Traffic Control
ATD	Aviation Training Device
CB	Cumulonimbus
CFA	Controlled Firing Areas
CFR	Code of Federal Regulations
CG	Center of Gravity
CP	Center of Pressure
CRM	Crew Resource Management
CTAF	Common Traffic Advisory Frequency
CTP	Certification Training Program
DPE	Designated Pilot Examiner
DVFR	Defense VFR
EMS	Emergency Services
FAA	Federal Aviation Administration
FADEC	Full Authority Digital Engine Control
FDA	Federal Drug Administration
FDC	Flight Data Center
FL	Flight Level
FRZ	Flight Restriction Zone
FS	Flight Service
FSDO	Flight Standards District Office
IAP	Instrument Approach Procedures

ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
IR	Instrument Routes (sectional charts)
ISA	International Standard Atmosphere
LAA	Local Airport Advisory
MAP	Missed Approach Point
MDA	Minimum Descent Altitude
MEL	Minimum Equipment List
MFD	Multi-functional Displays
MOA	Military Operation Areas
MSL	Mean Sea Level
MTR	Military Training Route
NACG	National Aeronautical Charting Group
NASA	National Aeronautics and Space Administration
NAS	National Airspace System
NM	Nautical Miles
NOAA	National Oceanic and Atmospheric Administration
NOTAM	Notice to Airmen
NSA	National Security Area
OTC	Over-the-Counter
PAVE	PIC – Aircraft – environment – External pressures
POH	Pilot's Operating Handbook
SAO	Special Area of Operation
SIGMET	Significant Meteorological Information
SOP	Standard Operating Procedures
TCU	Towering Cumulus
TFR	Temporary Flight Restrictions
TN	True North
TRSA	Terminal Radar Service Area
TUC	Time of Useful Consciousness
UNICOM	Aeronautical Advisory Communications Stations
UTC	Coordinated Universal Time
VFR	Visual Flight Rules
VR	Visual Routs (sectional charts)
VO	Visual Observer
W&B	Weight and Balance
WST	Convective Significant Meteorological Information

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