Chapter 4
Preflight Considerations

Introduction

The remote PIC is responsible for ensuring the sUAS is in a condition for safe operation. Part of this involves checking for proper loading, so that the device operates to the expected performance standards.

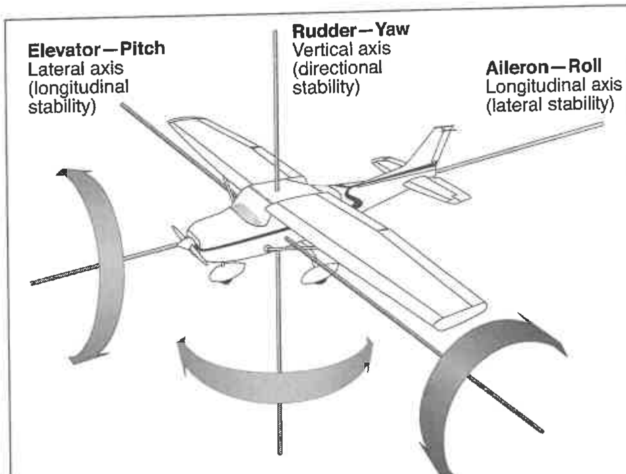
Prior to each flight, the remote PIC must ensure that any object attached to or carried by the small unmanned aircraft is secure and does not adversely affect the flight characteristics or controllability of the aircraft. For example, some sUA do not have a set holder or slot for the battery; instead, it is simply attached with hook-and-loop or other type of fastener. This allows some leeway on the lateral and longitudinal location of the battery on the sUA. Remote pilots should ensure the battery is installed in the proper location so it does not adversely affect the controllability of the aircraft. The attachments must be secure so the battery does not move during flight. Similar concerns exist and cautions advised if any external attachments are installed. Also be sure to close and lock (if applicable) all panels or doors.

Follow all manufacturer recommendations for evaluating performance to ensure safe and efficient operation. This manufacturer information may include operational performance details for the aircraft such as launch, climb, range, endurance, descent, and landing. It is important to understand the significance of the operational data to be able to make practical use of the aircraft's capabilities and limitations. The manufacturer's information regarding performance data is not standardized; availability and how this information is conveyed can vary greatly between sUAS types. If manufacturer-published performance data is unavailable, the remote pilot should seek out performance data that may have already been determined and published by other users of the same sUAS manufacturer model, and use that data as a starting point.

Check weather conditions prior to and during every sUAS flight and consider the effects of weather on aircraft performance.

Airplane flight control systems consist of primary and secondary systems. The ailerons, elevator (or stabilator) and rudder constitute the primary control system and are required to control an airplane safely during flight. Wing flaps, leading edge devices, spoilers and trim systems constitute the secondary control system and improve the performance characteristics of the airplane or relieve the pilot of excessive control forces. See Figure 4-1.

A helicopter has four flight control inputs: cyclic, collective, antitorque pedals, and throttle. The cyclic can vary the pitch of the rotor blades throughout each revolution of the main rotor system to develop lift (thrust). The result is to tilt the rotor disk in a particular direction, resulting in the helicopter moving in that direction.



Primary Control Surface	Airplane Movement	Axes of Rotation	Type of Stability
Aileron	Roll	Longitudinal	Lateral
Elevator/Stabilator	Pitch	Lateral	Longitudinal
Rudder	Yaw	Vertical	Directional

Figure 4-1. Aircraft flight controls

1186. 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.

Prior to each flight, the remote PIC must ensure that any object attached to or carried by the small unmanned aircraft is secure and does not adversely affect the flight characteristics or controllability of the aircraft. (UA.I.B.K2) — AC 107-2

1300. What purpose does a rudder perform on an sUAS airplane?

A—The rudder controls yaw.
B—The rudder controls bank.
C—The rudder controls pitch.

The purpose of the rudder is to control yaw. (UA.IV.A.K1b) — FAA-H-8083-25

Answer (B) is incorrect because the ailerons control bank. Answer (C) is incorrect because pitch is controlled by the elevator.

Determining Speed and Altitude

The remote pilot must not exceed these regulatory limitations for operating an sUAS:

- Cannot be flown faster than a ground speed of 87 knots (100 miles per hour).
- Cannot be flown higher than 400 feet AGL unless flown within a 400-foot radius of a structure and is not flown higher than 400 feet above the structure's immediate uppermost limit.

Some of the possible ways to ensure that 87 knots is not exceeded include:

- Installing a GPS device on the sUAS that reports ground speed information to the remote pilot, wherein the remote pilot takes into account the wind direction and speed and calculates the sUAS airspeed for a given direction of flight;
- Timing the ground speed of the sUAS when it is flown between two or more fixed points, taking into account wind speed and direction between each point, then noting the power settings of the sUAS to operate at or less than 87 knots ground speed;
- Using the sUAS manufacturer's design limitations (e.g., installed ground speed limiters);
- Using a radar gun to measure speed of the sUAS;
- Using an anemometer coupled with inertial information from onboard sensors; or
- Using inertial sensors capable of detecting wind speed and velocity as well as sUAS movement to determine ground speed.

These navigation terms are used in aviation as related to ground speed:

- **Dead reckoning** is navigation solely by means of computations based on time, airspeed, distance, and direction. The products derived from these variables, when adjusted by windspeed and velocity, are heading and ground speed.
- **Pilotage** is navigation by reference to landmarks or checkpoints.
- The **wind triangle** is navigation using triangulation. The true heading and the ground speed can be found by drawing a wind triangle of vectors. One side of the triangle is the wind direction and velocity; another side is the true heading and true airspeed, the last side is the track, or true course, and the ground speed. Each side of a wind triangle is the vector sum of the other two sides.

Answers

1186 [C] 1300 [A]

Some possible ways for a remote pilot to determine altitude above the ground or structure are as follows:

- Install a calibrated altitude reporting device on the sUAS that reports the sUAS altitude above mean sea level to the remote pilot, wherein the remote pilot subtracts the MSL elevation of the CS from the sUAS-reported MSL altitude to determine the sUAS altitude above the terrain or structure.
- Install a GPS device on the sUAS that also has the capability of reporting MSL altitude to the remote pilot (note that there may be minor errors associated with using this type of altitude reporting).
- With the sUAS on the ground, have the remote pilot and VO pace off 400 feet from the sUAS to get a visual perspective of the sUAS at that distance, wherein the remote pilot and VO maintain that visual perspective or closer while the sUAS is in flight.
- Use the known height of local rising terrain and/or structures as a reference.
- If the CS has a measure of distance between it and the sUA, fly directly overhead until reaching 400 feet and note the visual perspective.

In addition to local resources, the Sectional Chart for that region should be consulted for information on the altitude of the terrain and structures. Towers and other known obstructions are depicted with their altitude noted. It is critical to understand that altitude dimensions of airspace depicted on Sectional Charts are in MSL; remote pilots must be careful to properly convert between AGL and MSL as applicable to their equipment, operation, and regulation restrictions. See Legend 1 in the CT-8080-2.

1187. You are operating an sUAS that does not have GPS or an installed ground speed limiter. How can you determine the speed you are operating?

A—Dead reckoning.
B—Pilotage.
C—Wind triangle.

Without a GPS or manufacturer performance data, you can determine speed by timing the ground speed of the sUAS when it is flown between two or more fixed points, taking into account wind speed and direction between each point, then noting the power settings of the sUAS to operate at or less than 87 knots ground speed. This is a form of dead reckoning. (UA.IV.A.K2) — FAA-H-8083-25, AC 107-2

Answer (B) is incorrect because pilotage will help with navigating the Sectional Chart but cannot be used to determine ground speed. Answer (C) is incorrect because the wind triangle requires that you know true airspeed to determine ground speed; without instrumentation installed on the sUAS you won't have that information.

1188. How can a remote pilot determine the altitude of the terrain and structures where the flight will be conducted?

A—Sectional Chart.
B—Manufacturers data.
C—Road maps.

Refer to Legend 1. In addition to local resources, the sectional chart for that region should be consulted for information on the altitude of the terrain and structures. Towers and other known obstructions are depicted with their altitude noted. (UA.V.B.K6a) — Sectional Chart

1189. You are operating an sUAS that does not have GPS or an installed altimeter. How can you determine the altitude you are operating?

A—Gaining a visual perspective of what 400 feet looks like on the ground before the flight.
B—Operating a second sUAS that has an altimeter to gain a visual perspective of 400 feet from the air.
C—Operating the sUAS in close proximity of a tower known to be 400 feet tall.

To determine altitude, with the sUAS on the ground, the remote pilot and VO should pace off 400 feet from the sUAS to get a visual perspective of the sUAS at that distance, wherein the remote pilot and VO maintain that visual perspective or closer while the sUAS is in flight. (UA.IV.A.K2) — AC 107-2

Answer (B) is incorrect because a person may not operate or act as a remote PIC or VO in the operation of more than one UA at the same time. Answer (C) is incorrect because the remote PIC needs to adhere to wire strike avoidance procedures when operating near towers, which are likely to have guy wires.

Answers

1187 [A] 1188 [A] 1189 [A]

Loading

As with any aircraft, compliance with weight and balance limits is critical to the safety of flight for sUAS. An unmanned aircraft that is loaded out of balance may exhibit unexpected and unsafe flight characteristics. An overweight condition may cause problematic control or performance limitations. Before any flight, verify that the unmanned aircraft is correctly loaded by determining the weight and balance condition.

- Review any available manufacturer weight and balance data and follow all restrictions and limitations.
- If the manufacturer does not provide specific weight and balance data, apply general weight and balance principals to determine limits for a given flight. For example, add weight in a manner that does not adversely affect the aircraft's **center of gravity (CG)** location—a point at which the sUA would balance if it were suspended at that point. Usually this is located near the geographical center of multi-copters but may vary along the centerline of the fuselage of fixed-wing and single-rotor sUA.

Although a maximum gross launch weight may be specified, the aircraft may not always safely take off with this load under all conditions. Or if it does become airborne, the unmanned aircraft may exhibit unexpected and unusually poor flight characteristics. Conditions that affect launch and climb performance, such as high elevations, high air temperatures, and high humidity (high density altitudes) as well as windy conditions may require a reduction in weight before flight is attempted. Other factors to consider prior to launch 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. For battery-powered sUAS operations, weight change during flight may occur when expendable items are used on board (e.g., a jettisonable load such as an agricultural spray). Changes of mounted equipment between flights, such as the installation of different cameras, battery packs, or other instruments may also affect the weight and balance and performance of an sUAS.

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

Excessive weight reduces the flight performance in almost every respect. In addition, operating above the maximum weight limitation can compromise the structural integrity of an sUA. The most common performance deficiencies of an overloaded aircraft are:

- Reduced rate of climb;
- Lower maximum altitude;
- Shorter endurance; and
- Reduced maneuverability.

Prior to conducting a mission or extended flight, it is recommended to test-fly the sUA to determine if there are any unexpected performance issues due to loading. This testing should be done away from obstacles and people.

Computing Weight and Balance

The **empty weight** is obtained from manufacturers' documentation. It includes the airframe, power source, all fixed equipment, and unusable fuel. The **useful load** includes the power source (battery or fuel) and payload or mission equipment (such as a camera). The launch weight is the empty weight plus the useful load. The landing weight is the launch weight minus any fuel used or jettisoned load.

The **arm** is the horizontal distance measured in inches from the datum line (a reference point along the longitudinal axis indicated by the manufacturer) to a point on the sUAS. If measured aft, toward the defined rear of the aircraft, the arm is given a positive (+) value; if measured forward, toward the defined front, the arm is given a negative (-) value.

The **moment** is the product of the weight of an object multiplied by its arm and is expressed in pound-inches (lbs-in). The moment is essentially a force being applied at a location along the longitudinal axis, which must be countered by the control capabilities of the aircraft. If moment(s) exceed the control capacity of the aircraft, it becomes unstable or uncontrollable. The formula that is used to find moment is usually expressed as follows: Weight × Arm = Moment.

The CG is the point about which an aircraft will balance, and it is expressed in inches from datum. The CG is found by dividing the total moment by the total weight, and the formula is usually expressed as follows: Total Moment = CG (inches aft of datum) / Total Weight.

Lateral CG is also important (measured along the horizontal axis). Uneven distribution of weight on one side of the aircraft versus the other may cause controllability and/or performance issues.

1190. When loading cameras or other equipment on an sUAS, mount the items in a manner that

A—is visible to the visual observer or other crewmembers.
B—does not adversely affect the center of gravity.
C—can be easily removed without the use of tools.

Any mounted equipment should be balanced in a manner that does not adversely affect the CG or result in unsafe performance. (UA.IV.A.K1) — AC 107-2

1191. To ensure that the unmanned aircraft center of gravity (CG) limits are not exceeded, follow the aircraft loading instructions specified in the

A—Aircraft Weight and Balance Handbook.
B—Pilot's Operating Handbook or sUAS Flight Manual.
C—*Aeronautical Information Manual (AIM).*

Before any flight, verify that the unmanned aircraft is correctly loaded by determining the weight and balance condition. Review any available manufacturer weight and balance data and follow all restrictions and limitations. (UA.IV.A.K2) — FAA-H-8083-1

1192. What could be a consequence of operating a small unmanned aircraft above its maximum allowable weight?

A—Shorter endurance.
B—Increased maneuverability.
C—Faster speed.

Excessive weight reduces the flight performance in almost every respect, including a shorter endurance. In addition, operating above the maximum weight limitation can compromise the structural integrity of an unmanned aircraft. (UA.IV.A.K2) — AC 107-2

1193. When operating an aircraft, the remote PIC is responsible for using

A—the most current weight and balance data.
B—weight and balance data from the factory.
C—recent weight and balance data.

It is the responsibility of the remote PIC to use the most current weight and balance data when planning a flight and operating the sUAS. (UA.IV.A.K2) — FAA-H-8083-1

Answers

1190 [B] 1191 [B] 1192 [A] 1193 [A]

1194. Which of the following is true regarding weight and balance of small unmanned aircraft?

A—CG cannot change during flight.
B—Lateral CG is not important to small unmanned aircraft operations.
C—Operations outside weight and balance limitations may result in loss of control.

Loading the aircraft outside of limitations (weight, balance, or both) may lead to moments that exceed the capabilities of the flight controls/engine(s), thus possibly leading to loss of control or other performance anomalies. (UA.IV.A.K1b) — FAA-H8083-1

1293. A small unmanned aircraft loaded with the most rearward center of gravity is

A—less stable at all speeds.
B—more stable at slow speeds.
C—more stable at fast speeds.

Operation with the CG outside the approved limits results in control difficulty. (UA.IV.A.K1a) — FAA-H-8083-25

Load Factor

In aerodynamics, **load** is the force or imposed stress that must be supported by an sUA structure in flight. The loads imposed on the wings or rotors in flight are stated in terms of **load factor**. In straight-and-level flight, the sUAS wings/rotors support a load equal to the sum of the weight of the sUAS plus its contents. This particular load factor is equal to 1 G, where "**G**" refers to the pull of gravity. However, centrifugal force is generated which acts toward the outside of the curve any time an sUAS is flying a curved path (turns, climbs, or descents).

Unmanned aircraft performance can be decreased due to an increase in load factor when the aircraft is operated in maneuvers other than straight and level flight. The load factor increases at a significant rate after a bank (turn) has reached 45° or 50°. The load factor for any aircraft in a coordinated level turn at 60° bank is 2 Gs. The load factor in an 80° bank is 5.75 Gs. See Figure 4-2. The wing must produce lift equal to these load factors if altitude is to be maintained. The remote PIC should be mindful of the increased load factor and its possible effects on the aircraft's structural integrity and the results of an increase in stall speed. These principles apply to both fixed-wing and rotor-wing designs, but in the case of rotor-wing unmanned aircraft, the weight/load must be supported by the lift generated by the propellers.

As with manned aircraft, an unmanned aircraft will stall when critical angle of attack of the wing or rotors/propeller is exceeded. This can occur when an unmanned aircraft is turned too sharply/tightly or pitched up too steeply or rapidly. Remote pilots of rotor type unmanned aircraft should use particular caution when descending in a vertical straight line. In some cases, the turbulent downward airflow can disrupt the normal production of lift by the propellers as well as cause problematic air circulation producing vortices. These phenomena are referred to as vortex ring state or settling with power, and when they occur the aircraft can wobble, descend rapidly, or become uncontrollable. Recovery from this state of flight requires forward or rearward motion—counterintuitively, the addition of power to arrest the descent only makes the situation worse. Due to the low-altitude operating environment, consideration should be given to ensure aircraft control is maintained and the aircraft is not operated outside its performance limits.

Angle of bank	Load factor
0°	1.000
10°	1.015
30°	1.154
45°	1.414
60°	2.000
70°	2.923
80°	5.747
85°	11.473
90°	∞

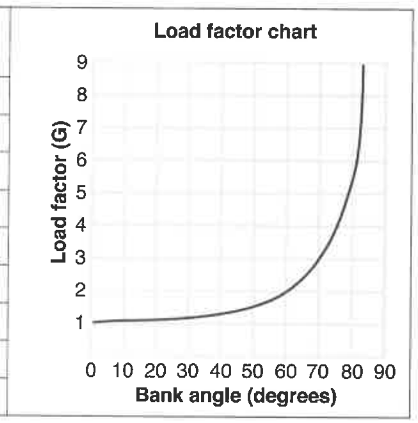


Figure 4-2. Load factor chart

Answers

1194 [C]
1293 [A]

1195. When operating an unmanned aircraft, the remote pilot-in-command should consider that the load factor on the wings or rotors may be increased anytime

A—the aircraft is subjected to maneuvers other than straight and level flight.
B—the CG is shifted rearward to the aft CG limit.
C—the gross weight is reduced.

Unmanned aircraft performance can be decreased due to an increase in load factor when the aircraft is operated in maneuvers other than straight-and-level flight. (UA.IV.A.K1a) — FAA-H-8083-25

1196. (Refer to Figure 2.) If an sUAS weighs 10 pounds, what approximate weight would the sUAS structure be required to support during a 60° banked turn while maintaining altitude?

A—10.15 pounds.
B—30 pounds.
C—20 pounds.

Refer to Figure 2 and use the following steps:

1. *Enter the chart at a 60° angle of bank and proceed upward to the curved reference line. From the point of intersection, move to the left side of the chart and read a load factor of 2 Gs.*
2. *Multiply the aircraft weight by the load factor: 10 × 2 = 20 lbs. Or, working from the table: 10 × 2.0 (load factor) = 20 lbs.*

(UA.IV.A.K1a) — FAA-H-8083-25

1197. (Refer to Figure 2.) If an sUAS weighs 50 pounds, what approximate weight would the sUAS structure be required to support during a 30° banked turn while maintaining altitude?

A—60 pounds.
B—45 pounds.
C—30 pounds.

Referencing Figure 2, use the following steps:

1. *Enter the chart at a 30° angle of bank and proceed upward to the curved reference line. From the point of intersection, move to the left side of the chart and read an approximate load factor of 1.2 Gs.*
2. *Multiply the aircraft weight by the load factor: 50 × 1.2 = 60 lbs. Or, working from the table: 50 1.154 (load factor) = 57.7 lbs.*

(UA.IV.A.K1a) — FAA-H-8083-25

Answers (B) and (C) are incorrect because they are less than 50 pounds; load factor increases with bank for level flight.

1198. (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.

Referencing Figure 2, use the following steps:

1. *Enter the chart at a 30° angle of bank and proceed upward to the curved reference line. From the point of intersection, move to the left side of the chart and read an approximate load factor of 1.2 Gs.*
2. *Multiply the aircraft weight by the load factor: 33 × 1.2 = 39.6 lbs. Or, working from the table: 33 × 1.154 (load factor) = 38.1 lbs.*

(UA.IV.A.K1a) — FAA-H-8083-25

1199. 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.

At slow speeds, the maximum available lifting force of the wing is only slightly greater than the amount necessary to support the weight of the sUAS. However, at high speeds, the capacity of the flight controls, or a strong gust, may increase the load factor beyond safe limits. (UA.IV.A.K1a) — FAA-H-8083-25

Answer (A) is incorrect because the position of the CG affects the stability of the sUAS, but not the total load the wings can support. Answer (C) is incorrect because abrupt control inputs do not limit load.

Answers

1195 [A]	1196 [C]	1197 [A]	1198 [C]	1199 [B]

1200. Which basic flight maneuver increases the load factor on an sUAS as compared to straight-and-level flight?

A—Climbs.
B—Turns.
C—Stalls.

A change in speed during straight flight will not produce any appreciable change in load, but when a change is made in the sUAS flight path an additional load is imposed upon the structure. This is particularly true if a change in direction is made at high speeds with rapid, forceful control movements. (UA.IV.A.K1a) — FAA-H-8083-25

Answer (A) is incorrect because the load increases only as the angle of attack is changed, momentarily. Once the climb attitude has been set, the wings only carry the load produced by the weight of the aircraft. Answer (C) is incorrect because in a stall, the wings are not producing lift.

Stalls

An **airfoil** is a structure or body that produces a useful reaction to air movement. Airplane wings, helicopter rotor blades, and propellers are airfoils. The **chord line** is an imaginary straight line from the leading edge to the trailing edge of an airfoil. In aerodynamics, **relative wind** is the wind "felt" or experienced by an airfoil. It is created by the movement of air past an airfoil, by the motion of an airfoil through the air, or by a combination of the two. Relative wind is parallel to, and in the opposite direction of the flight path of the airfoil. The **angle of attack** is the angle between the chord line of the airfoil and the relative wind. Angle of attack is directly related to the generation of lift by an airfoil. See Figures 4-3 through 4-6.

As the angle of attack is increased (to increase lift), the air will no longer flow smoothly over the upper airfoil surface but instead will become turbulent or "burble" near the trailing edge. A further increase in the angle of attack will cause the turbulent area to expand forward. At an angle of attack of approximately 18° to 20° (for most airfoils), turbulence over the upper wing surface decreases lift so drastically that flight cannot be sustained and the airfoil stalls. See Figure 4-7. The angle at which a stall occurs is called the **critical angle of attack**. An unmanned aircraft can stall at any airspeed or any attitude, but will always stall at the same critical angle of attack. The critical angle of attack of an airfoil is a function of its design therefore does not change based upon weight, maneuvering, or density altitude. However, the airspeed (strength of the relative wind) at which a given aircraft will stall in a particular configuration will remain the same regardless of altitude.

Because air density decreases with an increase in altitude, an unmanned aircraft must have greater forward speed to encounter the same strength of relative wind as would be experienced with the thicker air at lower altitudes. An easier way to envision this concept is to imagine how many molecules of air pass over an airfoil per second—thicker air at lower altitudes has more air molecules for a given area than the thinner air at higher altitudes. In order to successfully keep an aircraft aloft, a minimum number of air molecules must pass over the airfoil per second. As fewer molecules are available to make the journey as altitude increases, the only way to ensure that the aircraft can stay aloft is to increase its forward speed, thus forcing more air molecules over the airfoil each second.

Answers

1200 [B]

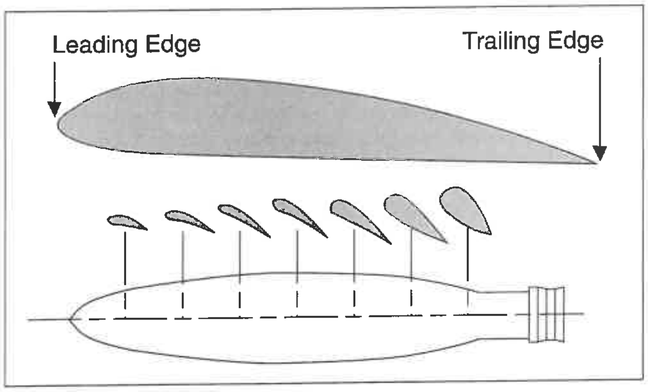


Figure 4-3. A typical airfoil cross-section

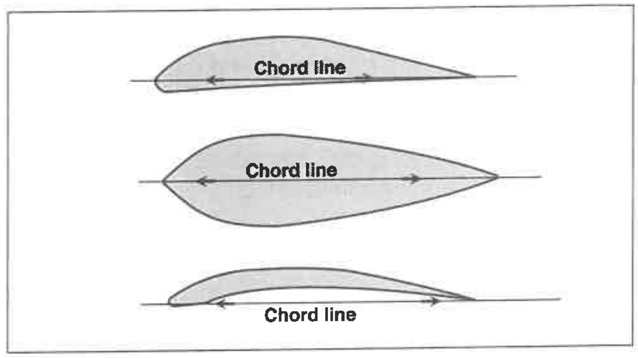


Figure 4-4. Chord line

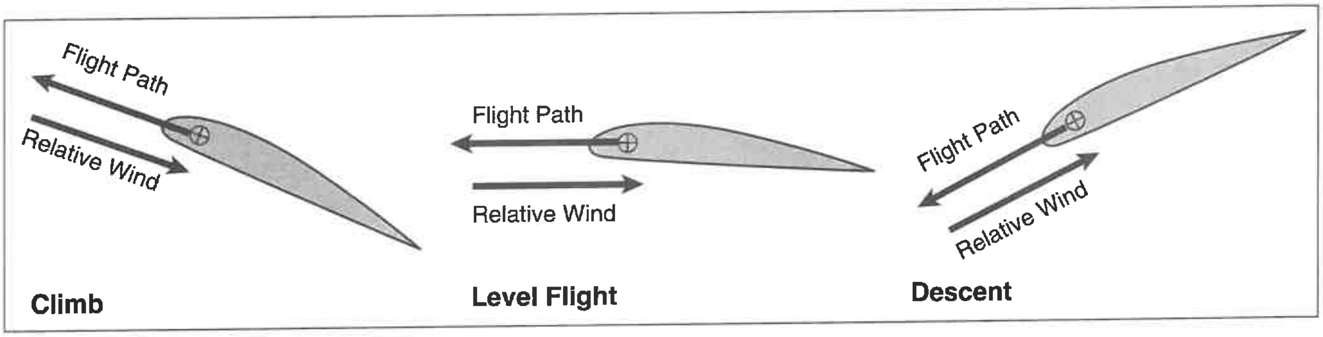


Figure 4-5. Relative wind

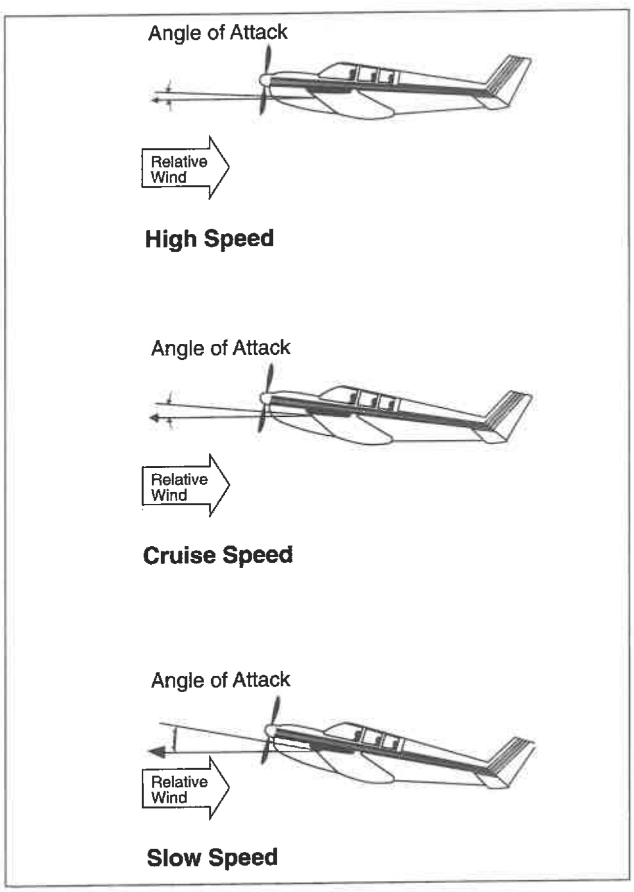


Figure 4-6. Angle of attack

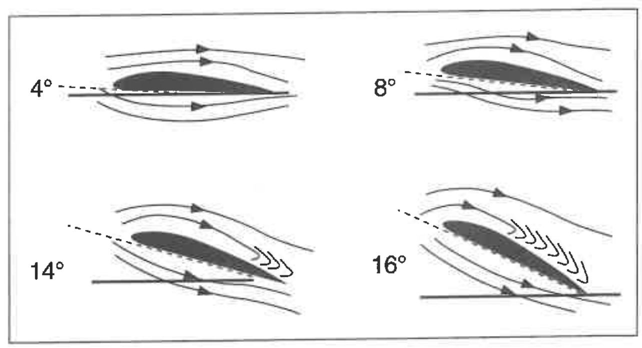


Figure 4-7. Flow of air over wing at various angles of attack

1201. The term "angle of attack" is defined as the angle

A—between the wing chord line and the relative wind.
B—between the airplane's climb angle and the horizon.
C—formed by the longitudinal axis of the airplane and the chord line of the wing.

The angle of attack is the acute angle between the relative wind and the chord line of the wing. (UA.IV.A.K1b) — FAA-H-8083-25

Answer (B) is incorrect because there is no specific aviation term for this. Answer (C) is incorrect because this is the definition of the angle of incidence.

1202. The angle of attack at which an airfoil stalls will

A—increase if the CG is moved forward.
B—remain the same regardless of gross weight.
C—change with an increase in gross weight.

When the angle of attack is increased to between 18° and 20° (critical angle of attack) on most airfoils, the airstream can no longer follow the upper curvature of the wing because of the excessive change in direction. The airfoil will stall if the critical angle of attack is exceeded. The airspeed at which stall occurs will be determined by weight and load factor, but the stall angle of attack is the same. (UA.IV.A.K1b) — FAA-H-8083-25

1203. A stall occurs when the smooth airflow over the unmanned aircraft's wing/propeller(s) is disrupted, and the lift degenerates rapidly. This is caused when the wing/propeller(s)

A—exceeds maximum allowable operating weight.
B—exceeds the maximum speed.
C—exceeds its critical angle of attack.

The airfoil will stall if the critical angle of attack is exceeded. (UA.IV.A.K1b) — FAA-H-8083-3

Answer (A) is incorrect because while exceeding the maximum allowable operating weight could compromise the structural integrity and decrease controllability, it does not necessarily result in a stall. Answer (B) is incorrect because while the remote pilot may not fly faster than 87 knots (100 mph) or the manufacturer recommended maximum speed, exceeding these do not necessarily result in a stall.

1204. An increase in load factor will cause an unmanned aircraft to

A—stall at a higher airspeed.
B—have a tendency to spin.
C—be more difficult to control.

Stall speed increases in proportion to the square root of the load factor. Thus, with a load factor of 4, an aircraft will stall at a speed which is double the normal stall speed. (UA.IV.A.K1b) — FAA-H-8083-25

Answer (B) is incorrect because an airplane's tendency to spin does not relate to an increase in load factors. Answer (C) is incorrect because an airplane's stability determines its controllability.

1314. In a 45° banking turn, a small unmanned aircraft will

A—be more susceptible to spinning.
B—stall at a higher airspeed.
C—stall at a lower airspeed.

Stall speed increases in proportion to the square root of the load factor. Thus, with a load factor of 4, an aircraft will stall at a speed which is double the normal stall speed. (UA.IV.A.K1b) — FAA-H-8083-25

Performance

Performance or operational information may be provided by the manufacturer in the form of POH, owner's manual, or on the manufacturer's website. Follow all manufacturer recommendations for evaluating performance to ensure safe and efficient operation. Even when specific performance data is not provided, the remote PIC should be familiar with:

- The operating environment.
- All available information regarding the safe and recommended operation of the sUAS.
- Conditions that may impact the performance or controllability of the sUAS.

Even when operational data is not supplied by the manufacturer, the remote PIC can better understand the unmanned aircraft's capabilities and limitations by establishing a process for tracking malfunctions,

Answers

1201 [A] 1202 [B] 1203 [C] 1204 [A] 1314 [B] defects, and flight characteristics in various environments and conditions. Use this operational data to establish a baseline for determining performance, reliability, and risk assessment for your particular system.

The remote PIC is responsible for ensuring that every flight can be accomplished safely, does not pose an undue hazard, and does not increase the likelihood of a loss of positive control. Consider how your decisions affect the safety of flight. For example:

- If you attempt flight in windy conditions, the unmanned aircraft may require an unusually high power setting to maneuver. This action may cause a rapid depletion of battery power and result in a failure mode.
- If you attempt flight in wintery weather conditions, ice may accumulate on the unmanned aircraft's surface. Ice increases the weight and adversely affects performance characteristics of the small unmanned aircraft.

Due to the diversity and rapidly evolving nature of sUAS operations, individual remote PICs have flexibility to determine what equipage methods, if any, mitigate risk sufficiently to meet performance-based requirements, such as the prohibition against creating an undue hazard if there is a loss of aircraft control.

1205. 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.

The remote PIC is responsible for ensuring that every flight can be accomplished safely, does not pose an undue hazard, and does not increase the likelihood of a loss of positive control. (UA.I.B.K4) — 14 CFR §107.12

1206. What effect does an uphill terrain slope have on launch performance?

A—Increases launch speed.
B—Increases launch distance.
C—Decreases launch distance.

The effect of runway slope on launch distance is due to the component of weight along the inclined path of the aircraft. An upslope would contribute a retarding force component, while a downslope would contribute an accelerating force component. In the case of an upslope, the retarding force component adds to drag and rolling friction to reduce the net accelerating force. (UA.IV.A.K2) — FAA-H-8083-25

Answer (A) is incorrect because runway slope has no effect on the launch speed. Answer (C) is incorrect because an upslope will increase the launch distance required.

1207. The most critical conditions of launch performance are the result of some combination of high gross weight, altitude, temperature, and

A—unfavorable wind.
B—obstacles surrounding the launch site.
C—powerplant systems.

The most critical conditions of launch performance are the result of some combination of high gross weight, altitude, temperature, and unfavorable wind. In all cases, the remote pilot must make an accurate prediction of takeoff distance from the performance data of the POH, regardless of the runway available, and strive for polished, professional launch procedures. (UA.III.B.K1b) — FAA-H-8083-25

1208. Maximum endurance is obtained at the point of minimum power to maintain the aircraft

A—in steady, level flight.
B—in a long range descent.
C—at its slowest possible indicated airspeed.

The maximum endurance condition is obtained at the point of minimum power required since this would require the lowest fuel flow or battery to keep the sUAS in steady, level flight. Maximum range condition occurs where the proportion between speed and power required is greatest. (UA.IV.A.K2) — FAA-H-8083-25

Answers

1205 [A] 1206 [B] 1207 [A] 1208 [A]

1209. When range and economy of operation are the principle goals, the remote pilot must ensure that the sUAS will be operated at the recommended

A—specific endurance.
B—long-range cruise performance.
C—equivalent airspeed.

Total range is dependent on both fuel available and specific range. When range and economy of operation are the principle goals, the remote pilot must ensure that the sUAS is operated at the recommended long-range cruise condition. By this procedure, the sUAS will be capable of its maximum design-operating radius, or can achieve lesser flight distances with a maximum of fuel reserve at the destination. (UA.IV.A.K2) — FAA-H-8083-25

1210. What is the best source for sUAS performance data and information?

A—Manufacturer publications.
B—Pilot reports.
C—Estimates based upon similar systems.

The manufacturer is the best source of performance data and information, if available. (UA.IV.A.K2) — FAA-H-8083-25

Physiology

Remote pilots are not required to hold a medical certificate. However, no person may manipulate the flight controls of an sUAS or act as a remote PIC, VO, or direct participant in the operation of the sUA if he or she knows or has reason to know that he or she has a physical or mental condition that would interfere with the safe operation of the sUAS. Remote pilots must self-assess their fitness for flight. Pilot performance can be seriously degraded by a number of physiological factors. While some of the factors may be beyond the control of the pilot, awareness of cause and effect can help minimize any adverse effects. At any time a remote PIC determines that they or another crewmember is unfit to operate the sUAS or participate in its operation, the remote PIC should terminate the operation and/or follow contingency plans for such occasions (e.g., incapacitation).

Hyperventilation, a deficiency of carbon dioxide within the body, can be the result of rapid or extra deep breathing due to emotional tension, anxiety, or fear. Symptoms will subside after the rate and depth of breathing are brought under control. A pilot should be able to overcome the symptoms or avoid future occurrences of hyperventilation by talking aloud, breathing into a bag, or slowing the breathing rate.

The sUAS operating environment can be very extreme for crewmembers. It is not uncommon for sUAS operations to take place in hot, dry and dusty locations, which can lead to dehydration and/or heat stroke. Alternatively, sUAS also operate in cold or other conditions that leave crewmembers exposed to the elements that could lead to dehydration and hypothermia. **Dehydration** is the term given to a critical loss of water from the body. Causes of dehydration are environmental conditions, wind, humidity, and diuretic drinks (i.e., coffee, tea, alcohol, and caffeinated soft drinks). Some common signs of dehydration are headache, fatigue, cramps, sleepiness, and dizziness. To help prevent dehydration, drink two to four quarts of water every 24 hours.

Heatstroke is a condition caused by any inability of the body to control its temperature. Onset of this condition may be recognized by the symptoms of dehydration, but also has been known to be recognized only upon complete collapse.

Hypothermia is indicated by shivering, clumsiness, slurred speech, confusion, low energy, discoloration of the skin (red or blue), and loss of consciousness. Remote PICs should ensure that they and their fellow crewmembers are adequately prepared for the planned sUAS operation and the environment in

Answers

1209 [B] 1210 [A]

which this operation is set to take place. Some things to keep in mind are: providing ample water or other hydrating beverages, eye protection, sun protection, insect repellent, warm clothes or clothes suited for heat (whichever is appropriate), support equipment, and any other items deemed necessary for safety and comfort.

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

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 can result in mental fatigue. 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. **Chronic fatigue** is characterized by extreme fatigue or tiredness that doesn't go away with rest, and can't be explained by an underlying medical condition. Chronic fatigue can also occur when there is not enough time for a full recovery from repeated episodes of acute fatigue.

Chronic stress results with longer-term stresses and/or the mismanagement thereof and can result in serious health conditions such as anxiety, high blood pressure, a weakened immune system, depression, confusion, mental errors, insomnia, and memory loss. The best way to cope with chronic stress is to remove stressors as much as practical, take part in physical activity, and/or seek out the advice or care of a healthcare provider.

Vision is the most important body sense for safe flight. Major factors that determine how effectively vision can be used are the level of illumination and the technique of scanning the sky for other aircraft. Atmospheric haze and fog reduces the ability to see traffic or terrain during flight, making all features appear to be farther away than they actually are. Caution is always advised in areas of reduced visibility or low light.

Additionally, the remote PIC and crewmembers should take into account the impact the environment may have on vision, such as location and angle of the sun, the color and texture of the local terrain features, as well as glare from water, buildings, or other objects. Particular caution is advised when operating near terrain features which may make it difficult to distinguish the sUAS from the surrounding environment or may make it difficult to ascertain proper depth perception (e.g., terrain colors similar to the sUA or a large area of trees which may make it more challenging to determine the distance between the unmanned aircraft and the foliage).

1254. Who is responsible for determining whether a pilot is fit to fly for a particular flight, even though he or she holds a current medical certificate?

A—The FAA.
B—The medical examiner.
C—The pilot.

The pilot is responsible for determining whether he or she is fit to fly for a particular flight. (UA.V.E.K7) — FAA-H-8083-25

1255. You are a remote pilot-in-command for a co-op energy service provider. You plan to use your unmanned aircraft to inspect powerlines in the remote area 15 hours away from your home office. After the drive, fatigue impacts your abilities to complete your assignment on time. What kind of fatigue is this?

A—Chronic fatigue.
B—Acute fatigue.
C—Exhaustion.

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. (UA.V.E.K5) — FAA-H-8083-25

1302. What can affect your performance?

A—Prescription medications.
B—Over-the-counter medications.
C—Over-the-counter and prescribed medications.

Virtually all medications have the potential for adverse side effects in some people. (UA.V.E.K3) — FAA-H-8083-25

1256. 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.

The fatigued pilot is an impaired pilot, and flying requires unimpaired judgment. (UA.V.E.K5) — FAA-H-8083-2

1257. Fatigue can be either

A—physiological or psychological.
B—physical or mental.
C—acute or chronic.

Fatigue can be either acute (short-term) or chronic (long-term). Acute fatigue, a normal occurrence of everyday living, is the tiredness felt after long periods of physical and mental strain, including strenuous muscular effort, immobility, heavy mental workload, strong emotional pressure, monotony, and lack of sleep. Chronic fatigue occurs when there is not enough time for a full recovery from repeated episodes of acute fatigue. (UA.V.E.K5) — FAA-H-8083-25

1258. Fatigue is one of the most treacherous hazards to flight safety

A—because it results in slow performance.
B—as it may not be apparent until serious errors are made.
C—as it may be a function of physical robustness or mental acuity.

Fatigue is one of the most treacherous hazards to flight safety as it may not be apparent to a pilot until serious errors are made. (UA.V.E.K5) — FAA-H-8083-25

1259. 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.

An abnormal increase in the volume of air breathed in and out of the lungs flushes an excessive amount of carbon dioxide from the lungs and blood, causing hyperventilation. (UA.V.E.K4) — AIM ¶8-1-3

1260. 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.

Hyperventilation is most likely to occur during periods of stress or anxiety. (UA.V.E.K4) — AIM ¶8-1-3

Answers

1254 [C]	1255 [B]	1302 [C]	1256 [B]	1257 [C]	1258 [B]
1259 [A]	1260 [A]				

1261. Which will almost always affect your ability to fly?

A—Over-the-counter analgesics and antihistamines.
B—Antibiotics and anesthetic drugs.
C—Prescription analgesics and antihistamines.

Pilot performance can be seriously degraded by both prescribed and OTC medications, as well as by the medical conditions for which they are taken. Flying is almost always precluded while using prescription analgesics since these drugs may cause side effects such as mental confusion, dizziness, headaches, nausea, and vision problems. Depressants, including antihistamines, lower blood pressure, reduce mental processing, and slow motor and reaction responses. (UA.V.E.K3) — FAA-H-8083-25

Answer (A) is incorrect because over-the-counter analgesics such as aspirin, Tylenol® and Advil®, and non-drowsy antihistamines (Claritin®, Allegra®, etc.) have few side effects when taken in the correct dosage. Answer (B) is incorrect because these drugs do not typically limit flying (but the medical conditions for which they are being taken may indeed limit flying activities).

1262. As a pilot, flying for long periods in hot summer temperatures increases the susceptibility of dehydration since the

A—dry air at altitude tends to increase the rate of water loss from the body.
B—moist air at altitude helps retain the body's moisture.
C—temperature decreases with altitude.

As a pilot, flying for long periods in hot summer temperatures or at high altitudes increases the susceptibility of dehydration since the dry air at altitude tends to increase the rate of water loss from the body. If this fluid is not replaced, fatigue progresses to dizziness, weakness, nausea, tingling of hands and feet, abdominal cramps, and extreme thirst. (UA.V.E.K1) — FAA-H-8083-25

1273. Which would most likely result in hyperventilation?

A—Insufficient oxygen.
B—Excessive carbon monoxide.
C—Insufficient carbon dioxide.

As hyperventilation blows off excessive carbon dioxide from the body, a pilot can experience symptoms of lightheadedness, suffocation, drowsiness, tingling of the extremities, and coolness and react to them with even greater hyperventilation. (UA.V.E.K4) — FAA-H-8083-25

Answer (A) is incorrect because insufficient oxygen is a symptom of hypoxia. Answer (B) is incorrect because excessive carbon monoxide will lead to carbon monoxide poisoning.

1263. When setting up the location of the control station and placement of crewmembers for an afternoon flight, which of the following would be most appropriate for ensuring that vision is not impaired by the environment?

A—The operation should be set up so that the remote PIC and crewmembers can face east.
B—The operation should be set up so that the remote PIC and crewmembers can face west.
C—The operation should be set up so that the remote PIC and crewmembers are facing any reflective objects in the area.

If the operation is to take place in the afternoon, the sun will be setting towards the west and could impair the vision of those participating in the sUAS operation. Thus, when practical, the operation should be set up to minimize the impact of the sun on being able to maintain visual line-of-sight with the unmanned aircraft. (UA.V.E.K6) — FAA-H-8083-25, 14 CFR §107.31

Answer (B) is incorrect because persons will have the sun in their eyes. Answer (C) is incorrect because it potentially will present glare or reflections into the eyes of participants.

1297. What can help a pilot mitigate stress?

A—Increasing stress tolerance.
B—Removing stress from personal life.
C—Breathing into a paper bag.

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. (UA.V.E.K5) — FAA-H-8083-25

Answers

1261 [C] 1262 [A] 1273 [C] 1263 [A] 1297 [B]

1264. When setting up the location of the control station and placement of crewmembers for a flight over snowy terrain, which of the following would be most appropriate for ensuring that vision is not impaired by the environment?

A—The operation should be set up so that the crewmembers are the most comfortable.
B—The operation should be set up so that the crewmembers will experience the minimum glare from the snow.
C—The operation should be set up so that the crewmembers face the direction in which the terrain most closely matches the color of the unmanned aircraft.

If the operation is to take place in a snow covered environment, awareness concerning how this may impact vision, such as glare or the ability to see and operate the unmanned aircraft against a featureless background. Thus, when practical, the operation should be set up to minimize the impact of the terrain on being able to maintain visual line-of-sight with the unmanned aircraft. (UA.V.E.K6) — FAA-H-8083-25, 14 CFR §107.31

Answer (A) is incorrect because while comfort is important, maintaining visual line-of-sight and positive control over the unmanned aircraft is more critical. Answer (C) is incorrect because it may make it difficult to keep the unmanned aircraft in sight, distinguished from the background, and/or may result in loss of depth perception.

1351. When preparing for a night flight, what should a small unmanned aircraft pilot be aware of after assembling and conducting a preflight of an aircraft while using a bright flashlight or work light?

A—Once adapted to darkness, a person's eyes are relatively immune to bright lights.
B—It takes approximately 30 minutes for a person's eyes to fully adapt to darkness.
C—The person should use a flashlight equipped with LED lights to facilitate their night vision.

When preparing for a night flight, a remote pilot should wait approximately 30 minutes for their eyes to adjust to darkness after exposure to bright light. (UA.V.E.K8) — FAA-H-8083-25

Maintenance and Inspection Procedures

Maintenance for sUAS includes scheduled and unscheduled overhaul, repair, inspection, modification, replacement, and system software upgrades for the unmanned aircraft itself and all components necessary for flight.

Manufacturers may recommend a maintenance or replacement schedule for the unmanned aircraft and system components based on time-in-service limits and other factors. Follow all manufacturer maintenance recommendations to achieve the longest and safest service life of the sUAS. If the sUAS or component manufacturer does not provide scheduled maintenance instructions, it is recommended that you establish your own scheduled maintenance protocol. For example:

- Document any repair, modification, overhaul, or replacement of a system component resulting from normal flight operations.
- Record the time-in-service for that component at the time of the maintenance procedure.
- Assess these records over time to establish a reliable maintenance schedule for the sUAS and its components.

During the course of a preflight inspection, you may discover that an sUAS component requires some form of maintenance outside of the scheduled maintenance period. For example, an sUAS component may require servicing (such as lubrication), repair, modification, overhaul, or replacement as a result

Answers

1264 [B]   1351 [B]

of normal or abnormal flight operations. Or, the sUAS manufacturer or component manufacturer may require an unscheduled system software update to correct a problem. In the event such a condition is found, do not conduct flight operations until the discrepancy is corrected.

In some instances, the sUAS or component manufacturer may require certain maintenance tasks be performed by the manufacturer or by a person or facility specified by the manufacturer; maintenance should be performed in accordance with the manufacturer's instructions. However, if you decide not to use the manufacturer or the personnel recommended by the manufacturer and you are unable to perform the required maintenance yourself, you should:

- Solicit the expertise of maintenance personnel familiar with the specific sUAS and its components.
- Consider using certificated maintenance providers, such as repair stations, holders of mechanic and repairman certificates, and persons working under the supervision of a mechanic or repairman.

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

Careful recordkeeping can be highly beneficial for sUAS owners and operators. For example, recordkeeping provides essential safety support for commercial operators who may experience rapidly accumulated flight operational hours/cycles. Consider maintaining a hardcopy and/or electronic logbook of all periodic inspections, maintenance, preventative maintenance, repairs, and alterations performed on the sUAS. See Figure 5-6. Such records should include all components of the sUAS, including the:

- Small unmanned aircraft itself;
- Control station;
- Launch and recovery equipment;
- Data link equipment;
- Payload; and
- Any other components required to safely operate the sUAS.

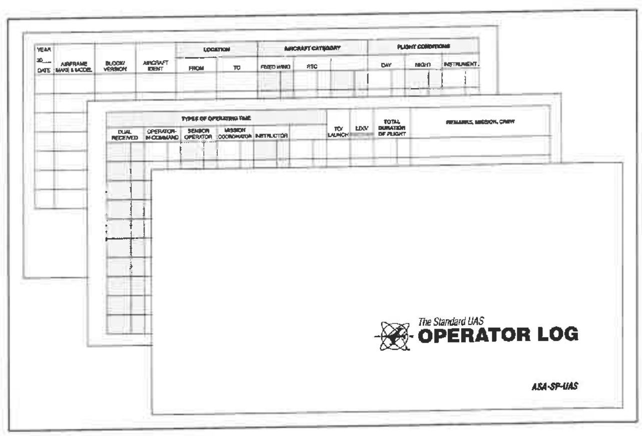


Figure 5-6. A UAS logbook can be used to track remote pilot hours as well as sUAS maintenance

1265. Which of the following sources of information should you consult first when determining what maintenance should be performed on an sUAS or its components?

A—Local pilot best practices.
B—14 CFR Part 107.
C—Manufacturer guidance.

The preferred source of information is the manufacturer's guidance about maintenance schedule and instructions. (UA.V.F.K1) — AC 107-2

1266. Under what condition should the operator of a small unmanned aircraft establish a scheduled maintenance protocol?

A—When the manufacturer does not provide a maintenance schedule.
B—When the FAA requires you to, following an accident.
C—Small unmanned aircraft systems do not require maintenance.

Follow all manufacturer maintenance recommendations to achieve the longest and safest service life of the sUAS. If the sUAS or component manufacturer does not provide scheduled maintenance instructions, it is recommended that you establish your own scheduled maintenance protocol. (UA.V.F.K1) — AC 107-2

1336. What action should the operator of an sUAS take if the manufacturer does not provide information about scheduled maintenance?

A—The operator should contact the FAA for a minimum equipment list.
B—The operator should establish a scheduled maintenance protocol.
C—The operator should contact the NTSB for component failure rates for their specific sUAS.

Follow all manufacturer maintenance recommendations to achieve the longest and safest service life of the sUAS. If the sUAS or component manufacturer does not provide scheduled maintenance instructions, it is recommended that you establish your own scheduled maintenance protocol. (UA.V.F.K1) — AC 107-2

1267. Scheduled maintenance should be performed in accordance with the

A—Manufacturer's suggested procedures.
B—Stipulations in 14 CFR Part 43.
C—Contractor requirements.

Follow all manufacturer maintenance recommendations to achieve the longest and safest service life of the sUAS. If the sUAS or component manufacturer does not provide scheduled maintenance instructions, it is recommended that you establish your own scheduled maintenance protocol. (UA.V.F.K1) — AC 107-2

1268. The responsibility for ensuring that an sUAS is maintained in an airworthy condition is primarily that of the

A—Remote pilot-in-command.
B—owner or operator.
C—mechanic who performs the work.

No person may operate a sUAS unless it is in a condition for safe operation. Prior to each flight, the remote PIC must check the sUAS to determine whether it is in a condition for safe operation. No person may continue flight of the sUA when he or she knows or has reason to know that the sUAS is no longer in a condition for safe operation. (UA.V.F.K2) — 14 CFR §107.15

1269. When should the battery for a small unmanned aircraft be replaced?

A—Once recharged more than 10 times in the preceding 30 days.
B—Per the guidelines of the sUAS manufacturer or the battery manufacturer, whichever is more restrictive.
C—Per the guidelines of the sUAS manufacturer or the battery manufacturer, whichever is least restrictive.

Follow all manufacturer maintenance recommendations to achieve the longest and safest service life of the sUAS. By abiding by the more restrictive limitation or component life cycle, the remote PIC will be assured of being in compliance of both the sUAS and battery manufacturer's guidelines. (UA.V.F.K1) — AC 107-2

Answers

1265 [C]	1266 [A]	1336 [B]	1267 [A]	1268 [A]	1269 [B]