Airplane Flying Handbook

Jason Schappert

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The Airplane Flying Handbook

by Jason Schappert ECFII

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The Airplane Flying Handbook

All Notes, Revisions, and Videos

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PURPOSE OF FLIGHT TRAINING

The overall purpose of primary and intermediate flight training, as outlined in this handbook, is the acquisition and honing of **basic airmanship skills.** **Airmanship** can be defined as:

- A sound acquaintance with the principles of flight,
- The ability to operate an airplane with competence and precision both on the ground and in the air, and
- The exercise of sound judgment that results in optimal operational safety and efficiency.

Learning to fly an airplane has often been likened to learning to drive an automobile. This analogy is misleading. Since an airplane operates in a different environment, three dimensional, it requires a type of motor skill development that is more sensitive to this situation such as:

- **Coordination**—The ability to use the hands and feet together subconsciously and in the proper relationship to produce desired results in the airplane.
- **Timing**—The application of muscular coordination at the proper instant to make flight, and all maneuvers incident thereto, a constant smooth process.
- **Control touch**—The ability to sense the action of the airplane and its probable actions in the immediate future, with regard to attitude and speed variations, by the sensing and evaluation of varying pressures and resistance of the control surfaces transmitted through the cockpit flight controls.
- **Speed sense**—The ability to sense instantly and react to any reasonable variation of airspeed.

An airman becomes one with the airplane rather than a machine operator. An accomplished airman demonstrates the ability to assess a situation quickly and accurately and deduce the correct procedure to be followed under the circumstance; to analyze accurately the probable results of a given set of circumstances or of a proposed procedure; to exercise care and due regard for safety; to gauge accurately the performance of the airplane; and to recognize

personal limitations and limitations of the airplane and avoid approaching the critical points of each. The development of airmanship skills requires effort and dedication on the part of both the student pilot and the flight instructor, beginning with the very first training flight where proper habit formation begins with the student being introduced to good operating practices.

Every airplane has its own particular flight characteristics. The purpose of primary and intermediate flight training, however, is not to learn how to fly a particular make and model airplane. The underlying purpose of flight training is to develop skills and safe habits that are transferable to any airplane. Basic airmanship skills serve as a firm foundation for this. The pilot who has acquired necessary airmanship skills during training, and demonstrates these skills by flying training-type airplanes with precision and safe flying habits, will be able to easily transition to more complex and higher performance airplanes. It should also be remembered that the goal of flight training is a safe and competent pilot, and that passing required practical tests for pilot certification is only incidental to this goal.

ROLE OF THE FAA

The Federal Aviation Administration (FAA) is empowered by the U.S. Congress to promote aviation safety by prescribing safety standards for civil aviation. This is accomplished through the Code of Federal Regulations (CFRs) formerly referred to as Federal Aviation Regulations (FARs).

Title 14 of the Code of Federal Regulations (14 CFR) part 61 pertains to the certification of pilots, flight instructors, and ground instructors. 14 CFR part 61 prescribes the eligibility, aeronautical knowledge, flight proficiency, and training and testing requirements for each type of pilot certificate issued.

14 CFR part 67 prescribes the medical standards and certification procedures for issuing medical certificates for airmen and for remaining eligible for a medical certificate.

14 CFR part 91 contains general operating and flight rules. The section is broad in scope and provides general guidance in the areas of general flight rules, visual flight rules (VFR), instrument flight rules (IFR), aircraft maintenance, and preventive maintenance and alterations.

Within the FAA, the Flight Standards Service sets the aviation standards for airmen and aircraft operations in the United States and for American airmen and aircraft around the world. The FAA Flight Standards Service is headquartered in Washington, D.C., and is broadly organized into divisions based on work function (Air Transportation, Aircraft Maintenance, Technical Programs, a Regulatory Support Division based in Oklahoma City, OK, and a General Aviation and Commercial Division). Regional Flight Standards division managers, one at each of the FAA's nine regional offices, coordinate Flight Standards activities within their respective regions.

The interface between the FAA Flight Standards Service and the aviation community/general public is the local Flight Standards District Office (FSDO). The approximately 90 FSDOs are strategically located across the United States, each office having jurisdiction over a specific geographic area. The individual FSDO is responsible for all air activity occurring within its geographic boundaries. In addition to accident investigation and the enforcement of aviation regulations, the individual FSDO is responsible for the certification and surveillance of air carriers, air operators, flight schools/training centers, and airmen including pilots and flight instructors.
Each FSDO is staffed by aviation safety inspectors whose specialties include operations, maintenance, and avionics. General aviation operations inspectors are highly qualified and experienced aviators. Once accepted for the position, an inspector must satisfactorily complete a course of indoctrination training conducted at the FAA Academy, which includes airman evaluation and pilot testing techniques and procedures. Thereafter, the inspector must complete recurrent training on a regular basis. Among other duties, the FSDO inspector is responsible for administering FAA practical tests for pilot and flight

instructor certificates and associated ratings. All questions concerning pilot certification (and/or requests for other aviation information or services) should be directed to the FSDO having jurisdiction in the particular geographic area. FSDO telephone numbers are listed in the blue pages of the telephone directory under United States Government offices, Department of Transportation, Federal Aviation Administration.

ROLE OF THE PILOT EXAMINER

Pilot and flight instructor certificates are issued by the FAA upon satisfactory completion of required knowledge and practical tests. The administration of these tests is an FAA responsibility normally carried out at the FSDO level by FSDO inspectors. The FAA, however, being a U.S. government agency, has limited resources and must prioritize its responsibilities. The agency's highest priority is the surveillance of certificated air carriers, with the certification of airmen (including pilots and flight instructors) having a lower priority.
In order to satisfy the public need for pilot testing and certification services, the FAA delegates certain of these responsibilities, as the need arises, to private individuals who are not FAA employees. A designated pilot examiner (DPE) is a private citizen who is designated as a representative of the FAA Administrator to perform specific (but limited) pilot certification tasks on behalf of the FAA, and may charge a reasonable fee for doing so. Generally, a DPE's authority is limited to accepting applications and conducting practical tests leading to the issuance of specific pilot certificates and/or ratings. A DPE operates under the direct supervision of the FSDO that holds the examiner's designation file. A FSDO inspector is assigned to monitor the DPE's certification activities. Normally, the DPE is authorized to conduct these activities only within the designating FSDO's jurisdictional area.
The FAA selects only highly qualified individuals to be designated pilot examiners. These individuals must have good industry reputations for professionalism, high integrity, a demonstrated willingness to serve the public, and adhere to FAA policies and procedures in certification matters. A designated pilot examiner is expected to administer practical tests with the same degree of professionalism, using the same methods, procedures, and standards as an FAA aviation safety inspector. It should be remembered, however, that a DPE is not an FAA aviation safety inspector. A DPE cannot initiate enforcement action, investigate accidents, or perform surveillance activities on behalf of the FAA. However, the majority of FAA practical tests at the recreational, private, and commercial pilot level are administered by FAA designated pilot examiners.

Jason's Note: I love checkrides! (your big final exam in flight training) Although you might be quite a good bit away from the big day it's important to take small steps each day and each lesson to work towards that goal of checkride success! Throughout this book I'll be sharing with you nuggets i've learned over the years to help you pass your checkride.

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ROLE OF THE FLIGHT INSTRUCTOR

The flight instructor is the cornerstone of aviation safety. The FAA has adopted an operational training concept that places the full responsibility for student training on the authorized flight instructor. In this role, the instructor assumes the total responsibility for training the student pilot in all the knowledge areas and skills necessary to operate safely and competently as a certificated pilot in the National Airspace System. This training will include airmanship skills, pilot judgment and decision making, and accepted good operating practices.

An FAA certificated flight instructor has to meet broad flying experience requirements, pass rigid knowledge and practical tests, and demonstrate the ability to apply recommended teaching techniques before being certificated. In addition, the flight instructor's certificate must be renewed every 24 months by showing continued success in training pilots, or by satisfactorily completing a flight instructor's refresher course or a practical test designed to upgrade aeronautical knowledge, pilot proficiency, and teaching techniques.

A pilot training program is dependent on the quality of the ground and flight instruction the student pilot receives. A good flight instructor will have a thorough understanding of the learning process, knowledge of the fundamentals of teaching, and the ability to communicate effectively with the student pilot.

A good flight instructor will use a syllabus and insist on correct techniques and procedures from the beginning of training so that the student will develop proper habit patterns. The syllabus should embody the "building block" method of instruction, in which the student progresses from the known to the unknown. The course of instruction should be laid out so that each new maneuver embodies the principles involved in the performance of those previously undertaken. Consequently, through each new subject introduced, the student not only learns a new principle or technique, but broadens his/her application of those previously learned and has his/her deficiencies in the previous maneuvers emphasized and made obvious.

The flying habits of the flight instructor, both during flight instruction and as observed by students when conducting other pilot operations, have a vital effect on safety. Students consider their flight instructor to be a paragon of flying proficiency whose flying habits they, consciously or unconsciously, attempt to imitate. For this reason, a good flight instructor will meticulously observe the safety practices taught the students. Additionally, a good flight instructor will carefully observe all regulations and recognized safety practices during all flight operations.

Generally, the student pilot who enrolls in a pilot training program is prepared to commit considerable time, effort, and expense in pursuit of a pilot certificate. The student may tend to judge the effectiveness of the flight instructor, and the overall success of the pilot training program, solely in terms of being able to pass the requisite FAA practical test. A good flight instructor, however, will be able to communicate to the student that evaluation through practical tests is a mere sampling of pilot ability that is compressed into a short period of time. The flight instructor's role, however, is to train the "total" pilot.

Jason's Note: Choosing a great flight instructor is crucial. When choosing a flight instructor I look for and make sure to ask 3 things:

1: Does your schedule match with the flight instructors? For example I personally don't fly on weekends. That might be a big bummer for someone with a full-time job or in school.

2: What are the instructors goals? You've got to understand that unfortunately flight instruction is usually a stepping stone for someone in their flying career. Now there are full time instructors out there! I'm just saying.... If your CFI says my goal is to get another 100 hours then I'm off to the airlines. That might not be a great choice for you. You may come in one day and not have a CFI.

3. Personality! You have got to do more than just get along with an instructor! You should respect them, befriend them, and trust them. If you don't feel it "click" when looking for CFI's move on to the next one.

SOURCES OF FLIGHT TRAINING

The major sources of flight training in the United States include FAA-approved pilot schools and training centers, non-certificated (14 CFR part 61) flying schools, and independent flight instructors. FAA “approved” schools are those flight schools certificated by the FAA as pilot schools under 14 CFR part 141 Application for certification is voluntary, and the school must meet stringent requirements for personnel, equipment, maintenance, and facilities. The school must operate in accordance with an established curriculum, which includes a training course outline (TCO) approved by the FAA. The TCO must contain student enrollment prerequisites, detailed description of each lesson including standards and objectives, expected accomplishments and standards for each stage of training, and a description of the checks and tests used to measure a student’s accomplishments. FAA-approved pilot school certificates must be renewed every 2 years. Renewal is contingent upon proof of continued high quality instruction and a minimum level of instructional activity. Training at an FAA certificated pilot school is structured. Because of this structured environment, the CFRs allow graduates of these pilot schools to meet the certification experience requirements of 14 CFR part 61 with less flight time. Many FAA certificated pilot schools have designated pilot examiners (DPEs) on their staff to administer FAA practical tests. Some schools have been granted examining authority by the FAA. A school with examining authority for a particular course or courses has the authority to recommend its graduates for pilot certificates or ratings without further testing by the FAA. A list of FAA certificated pilot schools and their training courses can be found in Advisory Circular (AC) 140-2, *FAA Certificated Pilot School Directory*.

FAA-approved training centers are certificated under 14 CFR part 142. Training centers, like certificated pilot schools, operate in a structured environment with approved courses and curricula, and stringent standards for personnel, equipment, facilities, operating procedures and record keeping. Training centers certificated under 14 CFR part 142, however, specialize in the use of flight simulation (flight simulators and flight training devices) in their training courses.

The overwhelming majority of flying schools in the United States are not certificated by the FAA. These schools operate under the provisions of 14 CFR part 61. Many of these non-certificated flying schools offer excellent training, and meet or exceed the standards required of FAA-approved pilot schools. Flight instructors employed by non-certificated flying schools, as well as independent flight instructors, must meet the same basic 14 CFR part 61 flight instructor requirements for certification and renewal as those flight instructors employed by FAA certificated pilot schools. In the end, any training program is dependent upon the quality of the ground and flight instruction a student pilot receives.

To learn more about the differences between learning part 61 vs part 141 visit

http://www.m0a.com/should-i-learn-to-fly-part-61-or-141/

PRACTICAL TEST STANDARDS

Practical tests for FAA pilot certificates and associated ratings are administered by FAA inspectors and designated pilot examiners in accordance with FAA-developed practical test standards (PTS). [Figure 1-3] 14 CFR part 61 specifies the areas of operation in which knowledge and skill must be demonstrated by the applicant. The CFRs provide the flexibility to permit the FAA to publish practical test standards containing the areas of operation and specific tasks in which competence must be demonstrated. The FAA requires that all practical tests be conducted in accordance with the appropriate practical test standards and the policies set forth in the Introduction section of the practical test standard book.

It must be emphasized that the practical test standards book is a testing document rather than a teaching document. An appropriately rated flight instructor is responsible for training a pilot applicant to acceptable standards in all subject matter areas, procedures, and maneuvers included in the tasks within each area of operation in the appropriate practical test standard. The pilot applicant should be familiar with this book and refer to the standards it contains during training. However, the practical test standard book is not intended to be used as a training syllabus. It contains the standards to which maneuvers/procedures on FAA practical tests must be performed and the FAA policies governing the administration of practical tests. Descriptions of tasks, and information on how to perform

maneuvers and procedures are contained in reference and teaching documents such as this handbook. A list of reference documents is contained in the Introduction section of each practical test standard book.

You can buy a copy of the PTS (and you will need one for your checkride) inside the MzeroA.com Pilot Shop

http://m0a.com/store

FLIGHT SAFETY PRACTICES

In the interest of safety and good habit pattern formation, there are certain basic flight safety practices and procedures that must be emphasized by the flight instructor, and adhered to by both instructor and student, beginning with the very first dual instruction flight. These include, but are not limited to, collision avoidance procedures including proper scanning techniques and clearing procedures, runway incursion avoidance, stall awareness, positive transfer of controls, and cockpit workload management.

COLLISION AVOIDANCE

All pilots must be alert to the potential for midair collision and near midair collisions. The general operating and flight rules in 14 CFR part 91 set forth the concept of “See and Avoid.” This concept requires that vigilance shall be maintained at all times, by each person operating an aircraft regardless of whether the operation is conducted under instrument flight rules (IFR) or visual flight rules (VFR). Pilots should also keep in mind their responsibility for continuously maintaining a vigilant lookout regardless of the type of aircraft being flown and the purpose of the flight. Most midair collision accidents and reported near midair collision incidents occur in good VFR weather conditions and during the hours of daylight. Most of these accident/incidents occur within 5 miles of an airport and/or near navigation aids.

The “See and Avoid” concept relies on knowledge of the limitations of the human eye, and the use of proper visual scanning techniques to help compensate for these limitations. The importance of, and the proper techniques for, visual scanning should be taught to a student pilot at the very beginning of flight training. The competent flight instructor should be familiar with the visual scanning and collision avoidance information contained in Advisory Circular (AC) 90-48, *Pilots’ Role in Collision Avoidance*, and the *Aeronautical Information Manual* (AIM).
There are many different types of clearing procedures. Most are centered around the use of clearing turns. The essential idea of the clearing turn is to be certain that the next maneuver is not going to proceed into another airplane’s flightpath. Some pilot training programs have hard and fast rules, such as requiring two 90° turns in opposite directions before executing any training maneuver. Other types of clearing procedures may be developed by individual flight instructors. Whatever the preferred method, the flight instructor should teach the beginning student an effective clearing procedure and insist on its use. The student pilot should execute the appropriate clearing procedure before all turns and before executing any training maneuver. Proper clearing procedures, combined with proper visual scanning techniques, are the most effective strategy for collision avoidance.

RUNWAY INCURSION AVOIDANCE

A runway incursion is any occurrence at an airport involving an aircraft, vehicle, person, or object on the ground that creates a collision hazard or results in a loss of separation with an aircraft taking off, landing, or intending to land. The three major areas contributing to runway incursions are:

Communications, Airport knowledge, and Cockpit procedures for maintaining orientation. Taxi operations require constant vigilance by the entire flight crew, not just the pilot taxiing the airplane. This is especially true during flight training operations. Both the student pilot and the flight instructor need to be continually aware of the movement and location of other aircraft and ground vehicles on the airport movement area. Many flight training activities are conducted at non-tower controlled airports. The absence of an operating airport control tower creates a need for increased vigilance on the part of pilots operating at those airports.

Planning, clear communications, and enhanced situational awareness during airport surface operations will reduce the potential for surface incidents. Safe aircraft operations can be accomplished and incidents eliminated if the pilot is properly trained early on and, throughout his/her flying career, accomplishes standard taxi operating procedures

and practices. This requires the development of the formalized teaching of safe operating practices during taxi operations. The flight instructor is the key to this teaching. The flight instructor should instill in the student an awareness of the potential for runway incursion, and should emphasize the runway incursion avoidance procedures contained in Advisory Circular (AC) 91-73, Part 91 *Pilot and Flightcrew Procedures During Taxi Operations and Part 135 Single-Pilot Operations*.

STALL AWARENESS

14 CFR part 61 requires that a student pilot receive and log flight training in stalls and stall recoveries prior to solo flight. During this training, the flight instructor should emphasize that the direct cause of every stall is an excessive angle of attack. The student pilot should fully understand that there are any number of flight maneuvers which may produce an increase in the wing's angle of attack, but the stall does not occur until the angle of attack becomes excessive. This "critical" angle of attack varies from 16 to 20° depending on the airplane design.

The flight instructor must emphasize that low speed is not necessary to produce a stall. The wing can be brought to an excessive angle of attack at any speed. High pitch attitude is not an absolute indication of proximity to a stall. Some airplanes are capable of vertical flight with a corresponding low angle of attack. Most airplanes are quite capable of stalling at a level or near level pitch attitude.

The key to stall awareness is the pilot's ability to visualize the wing's angle of attack in any particular circumstance, and thereby be able to estimate his/her margin of safety above stall. This is a learned skill that must be acquired early in flight training and carried through the pilot's entire flying career. The pilot must understand and appreciate factors such as airspeed, pitch attitude, load factor, relative wind, power setting, and aircraft configuration in order to develop a reasonably accurate mental picture of the wing's angle of attack at any particular time. It is essential to flight safety that a pilot take into consideration this visualization of the wing's angle of attack prior to entering any flight maneuver.

USE OF CHECKLISTS

Checklists have been the foundation of pilot standardization and cockpit safety for years. The checklist is an aid to the memory and helps to ensure that critical items necessary for the safe operation of aircraft are not overlooked or forgotten. However, checklists are of no value if the pilot is not committed to its use. Without discipline and dedication to using the checklist at the appropriate times, the odds are on the side of error. Pilots who fail to take the checklist seriously become complacent and the only thing they can rely on is memory.

The importance of consistent use of checklists cannot be overstated in pilot training. A major objective in primary flight training is to establish habit patterns that will serve pilots well throughout their entire flying career. The flight instructor must promote a positive attitude toward the use of checklists, and the student pilot must realize its importance. At a minimum, prepared checklists should be used for the following phases of flight.

- Preflight Inspection. • Before Engine Start. • Engine Starting. • Before Taxiing.
- Before Takeoff. • After Takeoff. • Cruise. • Descent.
- Before Landing. • After Landing. • Engine Shutdown and Securing.

POSITIVE TRANSFER OF CONTROLS

During flight training, there must always be a clear understanding between the student and flight instructor of who has control of the aircraft. Prior to any dual training flight, a briefing should be conducted that includes the procedure for the exchange of flight controls. The following three-step process for the exchange of flight controls is highly recommended.

When a flight instructor wishes the student to take control of the aircraft, he/she should say to the student, "You have the flight controls." The student should acknowledge immediately by saying, "I have the flight controls." The flight instructor confirms by again saying, "You have the flight controls." Part of the procedure should be a visual check to ensure that the other person actually has the flight controls. When returning the controls to the flight instructor, the student should follow the same procedure the instructor used when giving control to the student. The student should stay on the controls until the instructor says: "I have the flight controls." There should never be any

doubt as to who is flying the airplane at any one time. Numerous accidents have occurred due to a lack of communication or misunderstanding as to who actually had control of the aircraft, particularly between students and flight instructors. Establishing the above procedure during initial training will ensure the formation of a very beneficial habit pattern.

VIDEO NOTES

View My Video Notes and Breakdown of Each Chapter By Going To

TheAirplaneFlyingHandbook.com

VISUAL INSPECTION

The accomplishment of a safe flight begins with a careful visual inspection of the airplane. The purpose of the preflight visual inspection is twofold: to determine that the airplane is legally airworthy, and that it is in condition for safe flight. The airworthiness of the airplane is determined, in part, by the following certificates and documents, which must be on board the airplane when operated.

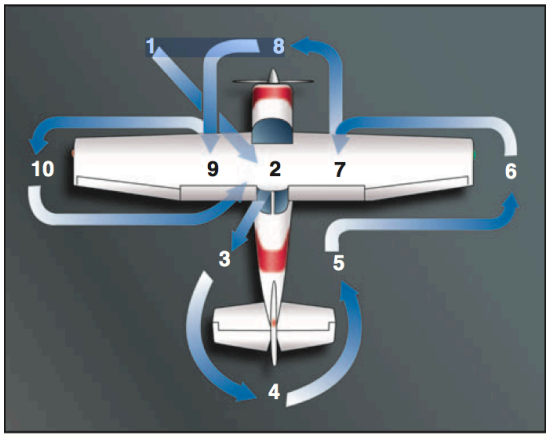

Figure 2-2. Preflight inspection.

Jason's Note: To help us remember what documents MUST be on the aircraft at all times we've developed the acronym ARROW.

A - Airworthiness Certificate
R - Registration Certificate
R - Radio License (For International Flight Only)
O - Operators Handbook
W - Weight and Balance.

Airworthiness certificate. Registration certificate.
FCC radio station license, if required by the type of operation.
Airplane operating limitations, which may be in the form of an FAA-approved Airplane Flight Manual and/or Pilot's Operating Handbook (AFM/POH), placards, instrument markings, or any combination thereof.
Airplane logbooks are not required to be kept in the airplane when it is operated. However, they should be inspected prior to flight to show that the airplane has had required tests and inspections. Maintenance records for the airframe and engine are required to be kept. There may also be additional propeller records.

At a minimum, there should be an annual inspection within the preceding 12-calendar months. In addition, the airplane may also be required to have a 100-hour inspection in accordance with Title14 of the Code of Federal Regulations (14 CFR) part 91, section 91.409(b).

If a transponder is to be used, it is required to be inspected within the preceding 24-calendar months. If the airplane is operated under instrument flight rules (IFR) in controlled airspace, the pitot-static system is also required to be inspected within the preceding 24-calendar months.

The emergency locator transmitter (ELT) should also be checked. The ELT is battery powered, and the battery replacement or recharge date should not be exceeded.

Airworthiness Directives (ADs) have varying compliance intervals and are usually tracked in a separate area of the appropriate airframe, engine, or propeller record.

Jason's Note: Please remember that EVERY preflight is different and this is to simply serve as just a guide. Do the preflight the way your aircraft checklist instructs. It's an open book test! Use that checklist.

The preflight inspection of the airplane should begin while approaching the airplane on the ramp. The pilot should make note of the general appearance of the airplane, looking for obvious discrepancies such as a landing gear out of alignment, structural distortion, skin damage, and dripping fuel or oil leaks. Upon reaching the airplane, all tiedowns, control locks, and chocks should be removed.

INSIDE THE COCKPIT

The inspection should start with the cabin door. If the door is hard to open or close, or if the carpeting or seats are wet from a recent rain, there is a good chance that the door, fuselage, or both are misaligned. This may be a sign of structural damage.

The windshield and side windows should be examined for cracks and/or crazing. Crazing is the first stage of delamination of the plastic. Crazing decreases visibility, and a severely crazed window can result in near zero visibility due to light refraction at certain angles to the sun.
The pilot should check the seats, seat rails, and seat belt attach points for wear, cracks, and serviceability.

The determination of whether the airplane is in a condition for safe flight is made by a preflight inspection of the airplane and its components. [Figure 2-2] The preflight inspection should be performed in accordance with a printed checklist provided by the airplane manufacturer for the specific make and model airplane. However, the following general areas are applicable to all airplanes.

Inside the cockpit, three key items to be checked are: (1) battery and ignition switches—off, (2) control column locks —*removed*, (3) landing gear control— *down and locked.*

The fuel selectors should be checked for proper operation in all positions—including the OFF position. Stiff selectors, or ones where the tank position is hard to find, are unacceptable. The primer should also be exercised. The pilot should feel resistance when the primer is both pulled out and pushed in. The primer should also lock securely. Faulty primers can interfere with proper engine operation. The engine controls should also be manipulated by slowly moving each through its full range to check for binding or stiffness.

The airspeed indicator should be properly marked, and the indicator needle should read zero. If it does not, the instrument may not be calibrated correctly. Similarly, the vertical speed indicator (VSI) should also read zero when the airplane is on the ground. If it does not, a small screwdriver can be used to zero the instrument. The VSI is the only flight instrument that a pilot has the prerogative to adjust. All others must be adjusted by an FAA certificated repairman or mechanic.

The magnetic compass is a required instrument for both VFR and IFR flight. It must be securely mounted, with a correction card in place. The instrument face must be clear and the instrument case full of fluid. A cloudy instrument face, bubbles in the fluid, or a partially filled case renders the instrument unusable.

The gyro driven attitude indicator should be checked before being powered. A white haze on the inside of

the glass face may be a sign that the seal has been breached, allowing moisture and dirt to be sucked into the instrument.

The altimeter should be checked against the ramp or field elevation after setting in the barometric pressure. If the variation between the known field elevation and the altimeter indication is more than 75 feet, its accuracy is questionable.

The pilot should turn on the battery master switch and make note of the fuel quantity gauge indications for comparison with an actual visual inspection of the fuel tanks during the exterior inspection.

The pilot should inspect for any signs of deterioration, distortion, and loose or missing rivets or screws, especially in the area where the outer skin attaches to the airplane structure. [Figure 2-6] The pilot should look along the wing spar rivet line—from the wingtip to the fuselage—for skin distortion. Any ripples and/or waves may be an indication of internal damage or failure.

Loose or sheared aluminum rivets may be identified by the presence of black oxide which forms rapidly when the rivet works free in its hole. Pressure applied to the skin adjacent to the rivet head will help verify the loosened condition of the rivet.

When examining the outer wing surface, it should be remembered that any damage, distortion, or malformation of the wing leading edge renders the airplane unairworthy. Serious dents in the leading edge, and disrepair of items such as stall strips, and deicer boots can cause the airplane to be aerodynamically unsound. Also, special care should be taken when examining the wingtips. Airplane wingtips are usually fiberglass. They are easily damaged and subject to cracking. The pilot should look at stop drilled cracks for evidence of crack progression, which can, under some circumstances, lead to in-flight failure of the wingtip.

The pilot should remember that fuel stains anywhere on the wing warrant further investigation—no matter how old the stains appear to be. Fuel stains are a sign of probable fuel leakage. On airplanes equipped with integral fuel tanks, evidence of fuel leakage can be found along rivet lines along the underside of the wing.

FUEL AND OIL

Particular attention should be paid to the fuel quantity, type and grade, and quality. Many fuel tanks are very sensitive to airplane attitude when attempting to fuel for maximum capacity. Nosewheel strut extension, both high as well as low, can significantly alter the attitude, and therefore the fuel capacity. The airplane attitude can also be affected laterally by a ramp that slopes, leaving one wing slightly higher than another. Always confirm the fuel quantity indicated on the fuel gauges by visually inspecting the level of each tank.

The type, grade, and color of fuel are critical to safe operation. The only widely available aviation gasoline (AVGAS) grade in the United States is low-lead 100-octane, or 100LL. AVGAS is dyed for easy recognition of its grade and has a familiar gasoline scent. Jet-A, or jet fuel, is a kerosene-based fuel for turbine powered airplanes. It has disastrous consequences when inadvertently introduced into reciprocating airplane engines. The piston engine operating on jet fuel may start, run, and power the airplane, but will fail because the engine has been destroyed from detonation.

Jet fuel has a distinctive kerosene scent and is oily to the touch when rubbed between fingers. Jet fuel is clear or straw colored, although it may appear dyed when mixed in a tank containing AVGAS. When a few drops of AVGAS are placed upon white paper, they evaporate quickly and leave just a trace of dye. In comparison, jet fuel is slower to evaporate and leaves an oily smudge. Jet fuel refueling trucks and dispensing equipment are marked with JET-A placards in white letters on a black background. Prudent pilots will supervise fueling to ensure that the correct tanks are filled with the right quantity, type, and grade of fuel. The pilot should always ensure that the fuel caps have been securely replaced following each fueling.

Engines certificated for grades 80/87 or 91/96 AVGAS will run satisfactorily on 100LL. The reverse is not true. Fuel of a lower grade/octane, if found, should never be substituted for a required higher grade. Detonation will severely damage the engine in a very short period of time.

Automotive gasoline is sometimes used as a substitute fuel in certain airplanes. Its use is acceptable only when the particular airplane has been issued a supplemental type certificate (STC) to both the airframe and engine allowing its use.

Checking for water and other sediment contamination is a key preflight element. Water tends to accumulate in fuel tanks from condensation, particularly in partially filled tanks. Because water is heavier than fuel, it tends to collect in the low points of the fuel system. Water can also be introduced into the fuel system from deteriorated gas cap seals exposed to rain, or from the supplier’s storage tanks and delivery vehicles. Sediment contamination can arise from dust and dirt entering the tanks during refueling, or from deteriorating rubber fuel tanks or tank sealant.

The best preventive measure is to minimize the opportunity for water to condense in the tanks. If possible, the fuel tanks should be completely filled with the proper grade of fuel after each flight, or at least filled after the last flight of the day. The more fuel there is in the tanks, the less opportunity for condensation to occur. Keeping fuel tanks filled is also the best way to slow the aging of rubber fuel tanks and tank sealant.

Sufficient fuel should be drained from the fuel strainer quick drain and from each fuel tank sump to check for fuel grade/color, water, dirt, and smell. If water is present, it will usually be in bead-like droplets, different in color (usually clear, sometimes muddy), in the bottom of the sample. In extreme cases, do not overlook the possibility that the entire sample, particularly a small sample, is water. If water is found in the first fuel sample, further samples should be taken until no water appears. Significant and/or consistent water or sediment contamination are grounds for further investigation by qualified maintenance personnel. Each fuel tank sump should be drained during preflight and after refueling.

The fuel tank vent is an important part of a preflight inspection. Unless outside air is able to enter the tank as fuel is drawn out, the eventual result will be fuel gauge malfunction and/or fuel starvation. During the preflight inspection,

the pilot should be alert for any signs of vent tubing damage, as well as vent blockage. A functional check of the fuel vent system can be done simply by opening the fuel cap. If there is a rush of air when the fuel tank cap is cracked, there could be a serious problem with the vent system.

The oil level should be checked during each preflight and rechecked with each refueling. Reciprocating airplane engines can be expected to consume a small amount of oil during normal operation. If the consumption grows or suddenly changes, qualified maintenance personnel should investigate. If line service personnel add oil to the engine, the pilot should ensure that the oil cap has been securely replaced.

Jason's Note: ALWAYS ALWAYS ALWAYS double check your fuel! I've had students do the silliest things from forgetting to put fuel caps on to dropping the fuel quantity stick in the fuel tank! (this actually happened twice) Sounds crazy but true! Don't mess around always sump and double check fuel caps.

LANDING GEAR, TIRES, AND BRAKES

Tires should be inspected for proper inflation, as well as cuts, bruises, wear, bulges, imbedded foreign object, and deterioration. As a general rule, tires with cord showing, and those with cracked sidewalls are considered unairworthy.

Brakes and brake systems should be checked for rust and corrosion, loose nuts/bolts, alignment, brake pad wear/ cracks, signs of hydraulic fluid leakage, and hydraulic line security/abrasion.
An examination of the nose gear should include the shimmy damper, which is painted white, and the torque link, which is painted red, for proper servicing and general condition. All landing gear shock struts should also be checked for proper inflation.

ENGINE AND PROPELLER

The pilot should make note of the condition of the engine cowling. [Figure 2-8] If the cowling rivet heads reveal aluminum oxide residue, and chipped paint surrounding and radiating away from the cowling rivet heads, it is a sign that the rivets have been rotating until the holes have been elongated. If allowed to continue,
the cowling may eventually separate from the airplane in flight.

Certain engine/propeller combinations require installation of a prop spinner for proper engine cooling. In these cases, the engine should not be operated unless the spinner is present and properly installed. The pilot should inspect the propeller spinner and spinner mounting plate for security of attachment, any signs of chafing of propeller blades, and defects such as cracking. A cracked spinner is unairworthy.
The propeller should be checked for nicks, cracks, pitting, corrosion, and security. The propeller hub should be checked for oil leaks, and the alternator/ generator drive belt should be checked for proper tension and signs of wear.

When inspecting inside the cowling, the pilot should look for signs of fuel dye which may indicate a fuel leak. The pilot should check for oil leaks, deterioration of oil lines, and to make certain that the oil cap, filter, oil cooler and drain plug are secure. The exhaust system should be checked for white stains caused by exhaust leaks at the cylinder head or cracks in the stacks. The heat muffs should also be checked for general condition and signs of cracks or leaks.

The air filter should be checked for condition and secure fit, as well as hydraulic lines for deterioration and/or leaks. The pilot should also check for loose or foreign objects inside the cowling such as bird nests, shop rags, and/or tools. All visible wires and lines should be checked for security and condition. And lastly, when the cowling is closed, the cowling fasteners should be checked for security.

COCKPIT MANAGEMENT

After entering the airplane, the pilot should first ensure that all necessary equipment, documents, checklists, and navigation charts appropriate for the flight are on board. If a portable intercom, headsets, or a hand-held global positioning system (GPS) is used, the pilot is responsible for ensuring that the routing of wires and cables does not interfere with the motion or the operation of any control.

Regardless of what materials are to be used, they should be neatly arranged and organized in a manner that makes them readily available. The cockpit and cabin should be checked for articles that might be tossed about if turbulence is encountered. Loose items should be properly secured. All pilots should form the habit of good housekeeping. The pilot must be able to see inside and outside references. If the range of motion of an adjustable seat is inadequate, cushions should be used to provide the proper seating position.

When the pilot is comfortably seated, the safety belt and shoulder harness (if installed) should be fastened and adjusted to a comfortably snug fit. The shoulder harness must be worn at least for the takeoff and landing, unless the pilot cannot reach or operate the controls with it fastened. The safety belt must be worn at all times when the pilot is seated at the controls.

If the seats are adjustable, it is important to ensure that the seat is locked in position. Accidents have occurred as the result of seat movement during acceleration or pitch attitude changes during takeoffs or landings. When the seat suddenly moves too close or too far away from the controls, the pilot may be unable to maintain control of the airplane.

14 CFR part 91 requires the pilot to ensure that each person on board is briefed on how to fasten and unfasten his/her safety belt and, if installed, shoulder harness. This should be accomplished before starting the engine, along with a passenger briefing on the proper use of safety equipment and exit information. Airplane manufacturers have printed briefing cards available, similar to those used by airlines, to supplement the pilot's briefing.

ENGINE STARTING

The specific procedures for engine starting will not be discussed here since there are as many different methods as there are different engines, fuel systems, and starting conditions. The before engine starting and engine starting checklist procedures should be followed. There are, however, certain precautions that apply to all airplanes. Some pilots have started the engine with the tail of the airplane pointed toward an open hangar door, parked automobiles, or a group of bystanders. This is not only discourteous, but may result in personal injury and damage to the property of others. Propeller blast can be surprisingly powerful.

When ready to start the engine, the pilot should look in all directions to be sure that nothing is or will be in the vicinity of the propeller. This includes nearby persons and aircraft that could be struck by the propeller blast or the debris it might pick up from the ground. The anti-collision light should be turned on prior to engine start, even during daytime operations. At night, the position (navigation) lights should also be on.
The pilot should always call "CLEAR" out of the side window and wait for a response from persons who may be nearby before activating the starter.

When activating the starter, one hand should be kept on the throttle. This allows prompt response if the engine falters during starting, and allows the pilot to rapidly retard the throttle if revolutions per minute (r.p.m.) are excessive after starting. A low r.p.m. setting (800 to 1,000) is recommended immediately following engine start. It is highly undesirable to allow the r.p.m. to race immediately after start, as there will be insufficient lubrication until the oil pressure rises. In freezing temperatures, the engine will also be exposed to potential mechanical distress until it warms and normal internal operating clearances are assumed.

As soon as the engine is operating smoothly, the oil pressure should be checked. If it does not rise to the manufacturer's specified value, the engine may not be receiving proper lubrication and should be shut down immediately to prevent serious damage.

Although quite rare, the starter motor may remain on and engaged after the engine starts. This can be detected by a continuous very high current draw on the ammeter. Some airplanes also have a starter engaged warning light specifically for this purpose. The engine should be shut down immediately should this occur.

Starters are small electric motors designed to draw large amounts of current for short periods of cranking. Should the engine fail to start readily, avoid continuous starter operation for periods longer than 30 seconds without a cool

down period of at least 30 seconds to a minute (some AFM/POH specify even longer). Their service life is drastically shortened from high heat through overuse.

HAND PROPPING

Jason's Note: There was an entire section here on hand propping (the method of starting the engine by throwing the propeller over) What you need to really know is that hand propping is dangerous and kills a few people every year because they had no idea how to do it properly.

Unless you're with someone who knows how to hand prop please don't EVER try it. Also please don't EVER try to hand prop an aircraft by yourself.

Sometimes it's just better to stay where your at and call your mechanic.

TAXIING

The following basic taxi information is applicable to both nosewheel and tailwheel airplanes.
Taxiing is the controlled movement of the airplane under its own power while on the ground. Since an airplane is moved under its own power between the parking area and the runway, the pilot must thoroughly understand and be proficient in taxi procedures.

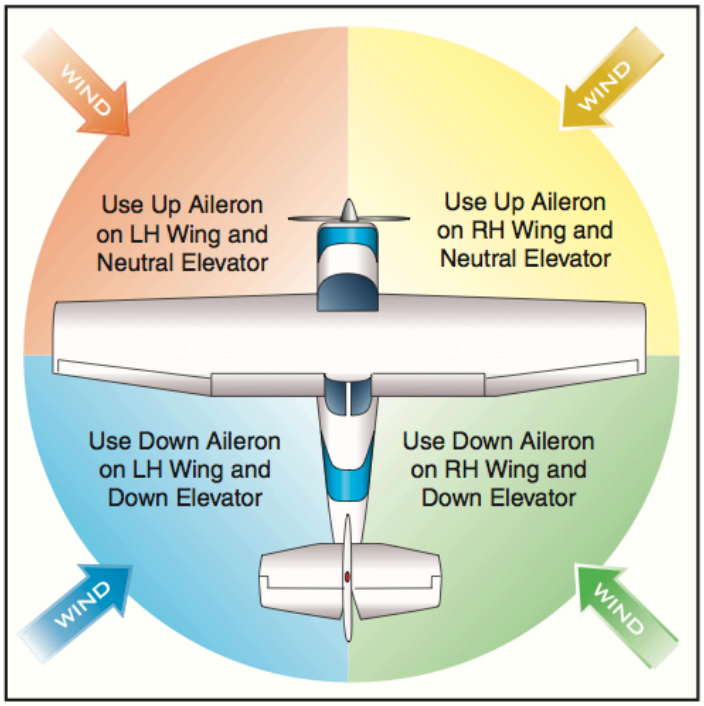

Figure 2-10. Flight control positions during taxi.

An awareness of other aircraft that are taking off, landing, or taxiing, and consideration for the right-of-way of others is essential to safety. When taxiing, the pilot's eyes should be looking outside the airplane, to the sides, as well as the front. The pilot must be aware of the entire area around the airplane to ensure that the airplane will clear all obstructions and other aircraft. If at any time there is doubt about the clearance from an object, the pilot should stop the airplane and have someone check the clearance. It may be necessary to have the airplane towed or physically moved by a ground crew.

It is difficult to set any rule for a single, safe taxiing speed. What is reasonable and prudent under some conditions may be imprudent or hazardous under others. The primary requirements for safe taxiing are positive control, the ability to recognize potential hazards in time to avoid them, and the ability to stop or turn where and when desired, without undue reliance on the brakes. Pilots should proceed at a cautious speed on congested or busy ramps. Normally, the speed should be at the rate where movement of the airplane is dependent on the throttle. That is, slow enough so when the throttle is closed, the airplane can be stopped promptly. When yellow taxiway centerline stripes are provided, they should be observed unless necessary to clear airplanes or obstructions.

Jason's Note: My rule of thumb is I should never be taxiing faster than I can walk.

moving forward slowly, then retarding the throttle and simultaneously applying pressure smoothly to both brakes does this. If braking action is unsatisfactory, the engine should be shut down immediately.
The presence of moderate to strong headwinds and/or a strong propeller slipstream makes the use of the elevator necessary to maintain control of the pitch attitude while taxiing. This becomes apparent when considering the lifting action that may be created on the horizontal tail surfaces by either of those two factors. The elevator control in

nosewheel-type airplanes should be held in the neutral position, while in tailwheel-type airplanes it should be held in the aft position to hold the tail down.

Downwind taxiing will usually require less engine power after the initial ground roll is begun, since the wind will be pushing the airplane forward. To avoid overheating the brakes when taxiing downwind, keep engine power to a minimum. Rather than continuously riding the brakes to control speed, it is better to apply brakes only occasionally. Other than sharp turns at low speed, the throttle should always be at idle before the brakes are applied. It is a common student error to taxi with a power setting that requires controlling taxi speed with the brakes. This is the aeronautical equivalent of driving an automobile with both the accelerator and brake pedals depressed.
When taxiing with a quartering headwind, the wing on the upwind side will tend to be lifted by the wind unless the aileron control is held in that direction (upwind aileron UP). Moving the aileron into the UP position reduces the effect of the wind striking that wing, thus reducing the lifting action. This control movement will also cause the downwind aileron to be placed in the DOWN position, thus a small amount of lift and drag on the downwind wing, further reducing the tendency of the upwind wing to rise.

When taxiing with a quartering tailwind, the elevator should be held in the DOWN position, and the upwind aileron, DOWN. [Figure 2-13] Since the wind is striking the airplane from behind, these control positions reduce the tendency of the wind to get under the tail and the wing and to nose the airplane over.

Do not ride the brakes. Reduce power and use brakes intermittently.

The application of these crosswind taxi corrections helps to minimize the weather-vaning tendency and ultimately results in making the airplane easier to steer.

Normally, all turns should be started using the rudder pedal to steer the nosewheel. To tighten the turn after full pedal deflection is reached, the brake may be applied as needed. When stopping the airplane, it is advisable to always stop with the nosewheel straight ahead to relieve any side load on the nosewheel and to make it easier to start moving ahead.

During crosswind taxiing, even the nosewheel-type airplane has some tendency to weathervane. However, the weather-vaning tendency is less than in tailwheel-type airplanes because the main wheels are located farther aft, and the nosewheel's ground friction helps to resist the tendency. [Figure 2-14] The nosewheel linkage from the rudder pedals provides adequate steering control for safe and efficient ground handling, and normally, only rudder pressure is necessary to correct for a crosswind.

BEFORE TAKEOFF CHECK

The before takeoff check is the systematic procedure for making a check of the engine, controls, systems, instruments, and avionics prior to flight. Normally, it is performed after taxiing to a position near the takeoff end of the runway. Taxiing to that position usually allows sufficient time for the engine to warm up to at least minimum operating temperatures. This ensures adequate lubrication and internal engine clearances before being operated at high power settings. Many engines require that the oil temperature reach a minimum value as stated in the AFM/POH before high power is applied.

Air-cooled engines generally are closely cowled and equipped with pressure baffles that direct the flow of air to the engine in sufficient quantities for cooling in flight. On the ground, however, much less air is forced through the cowling and around the baffling. Prolonged ground operations may cause cylinder overheating long before there is an indication of rising oil temperature. Cowl flaps, if available, should be set according to the AFM/POH.
Before beginning the before takeoff check, the airplane should be positioned clear of other aircraft. There should not be anything behind the airplane that might be damaged by the prop blast. To minimize overheating during engine runup, it is recommended that the airplane be headed as nearly as possible into the wind. After the airplane is properly positioned for the runup, it should be allowed to roll forward slightly so that the nosewheel or tailwheel will be aligned fore and aft.

During the engine runup, the surface under the airplane should be firm (a smooth, paved, or turf surface if possible) and free of debris. Otherwise, the propeller may pick up pebbles, dirt, mud, sand, or other loose objects and hurl them backwards. This damages the propeller and may damage the tail of the airplane. Small chips in the leading

edge of the propeller form stress risers, or lines of concentrated high stress. These are highly undesirable and may lead to cracks and possible propeller blade failure.

While performing the engine runup, the pilot must divide attention inside and outside the airplane. If the parking brake slips, or if application of the toe brakes is inadequate for the amount of power applied, the airplane could move forward unnoticed if attention is fixed inside the airplane.
Each airplane has different features and equipment, and the before takeoff checklist provided by the airplane manufacturer or operator should be used to perform the runup.

AFTER LANDING

During the after-landing roll, the airplane should be gradually slowed to normal taxi speed before turning off the landing runway. Any significant degree of turn at faster speeds could result in ground looping and subsequent damage to the airplane.

To give full attention to controlling the airplane during the landing roll, the after-landing check should be performed only after the airplane is brought to a complete stop clear of the active runway. There have been many cases of the pilot mistakenly grasping the wrong handle and retracting the landing gear, instead of the flaps, due to improper division of attention while the airplane was moving. However, this procedure may be modified if the manufacturer recommends that specific after-landing items be accomplished during landing rollout. For example, when performing a short-field landing, the manufacturer may recommend retracting the flaps on rollout to improve braking. In this situation, the pilot should make a positive identification of the flap control and retract the flaps.

CLEAR OF RUNWAY

Because of different features and equipment in various airplanes, the after-landing checklist provided by the manufacturer should be used. Some of the items may include:

- Flaps Up
- Carb Heat Off
- Transponder Standby

PARKING

Unless parking in a designated, supervised area, the pilot should select a location and heading which will prevent the propeller or jet blast of other airplanes from striking the airplane broadside. Whenever possible, the airplane should be parked headed into the existing or forecast wind. After stopping on the desired heading, the airplane should be allowed to roll straight ahead enough to straighten the nosewheel or tailwheel.

Turn ignition switch to OFF when engine stops. Turn master electrical switch to OFF. Install control lock.

POSTFLIGHT

A flight is never complete until the engine is shut down and the airplane is secured. A pilot should consider this an essential part of any flight.

ENGINE SHUTDOWN

Finally, the pilot should always use the procedures in the manufacturer’s checklist for shutting down the engine and securing the airplane. Some of the important items include:
Set the parking brakes ON.

Set throttle to IDLE or 1,000 r.p.m. If turbocharged, observe the manufacturer’s spool down procedure.
Turn ignition switch OFF then ON at idle to check for proper operation of switch in the OFF position.
Set propeller control (if equipped) to FULL INCREASE.

Turn electrical units and radios OFF. Set mixture control to IDLE CUTOFF.

SECURING AND SERVICING

After engine shutdown and deplaning passengers, the pilot should accomplish a postflight inspection. This includes checking the general condition of the aircraft. For a departure, the oil should be checked and fuel added if required. If the aircraft is going to be inactive, it is a good operating practice to fill the tanks to the top to prevent water condensation from forming. When the flight is completed for the day, the aircraft should be hangared or tied down and the flight controls secured.

Jason's Notes: This chapter is a great overview. However one thing you need to understand is every aircraft is different! The steps outlined in this chapter might change from aircraft to aircraft. Use your aircrafts checklist!

The checklist is really an open book test. Follow it step by step and you'll do just fine.

One last thing along those lines...

Take your time on that preflight. Don't rush it! Too many students fall into what's called complacency where they feel they "know everything" and rush through a preflight inspection.

Don't fall into this mental trap.