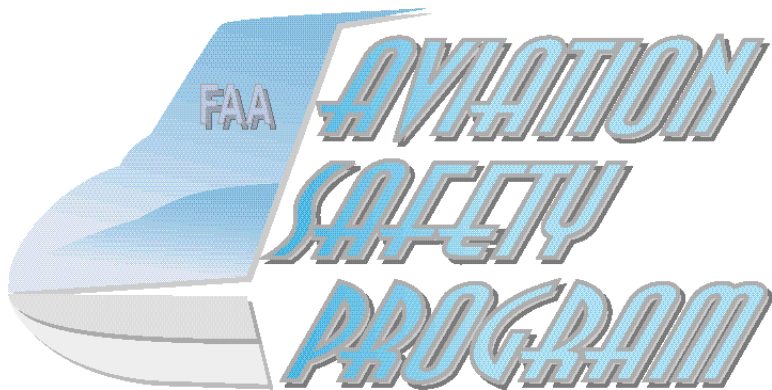


Meet Your Aircraft



FOREWORD

The purpose of this series of Federal Aviation Administration (FAA) Aviation Safety Program publications is to provide the aviation community with safety information that is informative, handy, and easy to review. Many of the publications in this series summarize material published in various FAA advisory circulars, handbooks, other publications, and various audiovisual products produced by the FAA and used in its Aviation Safety Program.

Some of the ideas and materials in this series were developed by the aviation industry. FAA acknowledges the support of the aviation industry and its various trade and membership groups in the production of this series.

Comments regarding these publications should be directed to the National Aviation Safety Program Manager, Federal Aviation Administration, Flight Standards Service, General Aviation and Commercial Division, Aviation Safety Program Branch, AFS-810, 800 Independence Avenue, SW, Washington, DC 20591. Attn: H. Dean Chamberlain, Editor.

HOW TO BEGIN

One of the most interesting challenges in aviation for any pilot is transitioning to a new type aircraft. Normally, the pilot's first question is, "How do I start?"

That question is an easy one to answer. The best way to transition to any new aircraft is to find a certificated flight instructor (CFI) qualified and current in the aircraft to teach you how to fly it safely. If the transition is to a high performance aircraft or one that requires a category or class rating or one that requires a type rating such as a turbojet, you might want to attend one of the many flight training schools that specialize in such training. Another option is to attend the aircraft manufacturer's training course for the model if the company offers such a course.

Regardless of where you attend training, the best way to transition to a new aircraft is to work with someone, preferably a CFI, who is current in the new aircraft. In some cases, you may need the appropriate CFI endorsement to fly the aircraft such as a high altitude, tailwheel, or high performance endorsement.

If you cannot find a CFI to fly with, the next step is try and find another experienced pilot who is current in the aircraft. This is especially true if the aircraft is an experimental aircraft or a very rare model. The reason is every aircraft is unique. By flying with someone current in the make and model of aircraft, the transitioning pilot gets the benefit of the other pilot's experience and knowledge plus the added safety of someone who knows the aircraft. What a transitioning pilot does not want to do is become a test pilot in a new aircraft.

HITTING THE BOOKS

With the question of how should I begin answered, the next question is where do I begin. You begin by studying and learning the new aircraft's systems and operating procedures since the bottom line to all flying is knowing everything that we can about the aircraft so we can operate it safely. You will find this information in the aircraft's flight manual (AFM), owner's manual, or pilot's operating handbook (POH). If the aircraft is an older model, it might have a very basic owner's manual. If so, you need to be aware that the older manuals may not have the same information as some of the newer manuals, nor are the older manuals organized like the newer POH's or AFM's. Although the older manuals have less information than the new manuals, they still

provide the basic information. The newer publications are similar in format and have the following sections: General; Limitations; Emergency Procedures; Normal Procedures; Performance; Weight and Balance/Equipment List; Systems Description; Handling, Service, and Maintenance; Supplements; and Safety Information.

Another good source of information on an aircraft, particularly older models, is magazine articles on the aircraft. Pilot reports are especially helpful.

COCKPIT FAMILIARIZATION

Once you have done your homework and thoroughly understand the new aircraft, you should take the aircraft's manual and checklist out to the aircraft and spend time sitting in the cockpit to learn the locations of the various controls, instruments, and checklist procedures. Your goal is to become familiar enough with the aircraft to be able to fly it before you ever start the engine. If you are renting the aircraft, this procedure also will save you valuable training dollars. You don't have to pay a CFI to teach you something that you can review on your own. When you are comfortable with the location of every item in the cockpit and with the aircraft's procedures and numbers, it is time to go flying with a CFI or pilot current in the aircraft.

CHECKOUT GUIDE

The following is a list of areas you should consider when transitioning to any type of aircraft:

1. Aircraft Systems.
2. Limitations which include performance, weight and balance, and V speeds.
3. Normal Procedures.
4. Abnormal and emergency procedures.
5. Aircraft paperwork and records.
6. Checkout by a current and qualified CFI or experienced pilot that knows the aircraft's particular flight characteristics. The checkout pilot should be current in make and model.

AIRCRAFT KNOWLEDGE

After reviewing the General section of the AFM or POH the Aircraft Systems portion is probably the best area to start serious study. If you start in another section, you may encounter terms you aren't familiar with if you haven't studied the various systems first. This is particularly true of the more complex and turbine powered aircraft. Aircraft systems not only include the engine, fuel, electrical, landing gear, control, and hydraulic systems but the avionics systems as well.

With today's rapid changes in avionics systems, a pilot must be very familiar with the newer equipment and how it is operated. This is especially important when flying in different aircraft that have different avionics packages. Pilots need to be aware that the new GPS and older LORAN-C receivers can have different control functions, programming, data displays, and operating procedures. Because each GPS or LORAN-C system is unique, the time to learn how to operate the system is when you are on the ground; not when you are in flight.

TYPES OF EQUIPMENT QUESTIONS TO ASK

The engine is a good place for transitioning pilots to start their study. Is it a turbine or recip? If it is a reciprocating engine, is it carburetor equipped, fuel injected, or turbocharged? What type fuel does it use? How much fuel does it carry? What is its usable fuel capacity? What is the average fuel burn rate in normal cruise? What type of fuel system does it have? Is it single tank or multiple tanks? Is fuel drawn from one tank at a time or is fuel drawn from all or multiple tanks simultaneously? Does the fuel gauge automatically indicate the fuel in the tank you have selected or is there a separate switch you must activate to get the fuel gauge to indicate the fuel quantity in the tank you have selected? Some aircraft have a separate switch for the fuel gauge. You can be looking at a fuel gauge that indicates plenty of fuel when the engine quits because you just drained a tank that the fuel quantity indicator was not set to. If this happens at low altitude, it could lead to a disaster. Even when the fuel quantity indicator indicates the tank selected or when there are multiple fuel quantity indicators there have been accidents due to fuel starvation because one tank was drained and the fuel selector had not been switched to the tank that had plenty of fuel in it. How does the crossfeed work? In multi-engine aircraft the crossfeed may work differently in different aircraft. These are only a few of the types of questions a pilot

needs to answer when transitioning to a new aircraft.

HABITS CAN BE DANGEROUS

Although knowledge of the new aircraft's operating systems is important, pilots must also be aware that old operating habits can be deadly when transitioning between aircraft. For example, since we just discussed how different aircraft can have different fuel operating systems, let's suppose you lose an engine in a twin you are transitioning to on a dark and stormy night. Now let's suppose in the stress of the moment, you revert to an old habit. You use the crossfeed procedures for a twin you normally fly instead of the different procedure for the new aircraft. You might just have shut off the fuel to your only remaining operating engine.

Another example of how a habit can cause you a problem in a new aircraft is using the wrong technique to lean the engine. There is at least one make and model of aircraft that will use substantially more fuel than the performance charts indicate if you use the traditional leaning technique from habit. We have been taught to lean until we get peak RPM (in aircraft with fixed-pitch propellers), then enrich the mixture until there is a 25-50 RPM drop. However, in at least one aircraft the leaning instructions are to lean until the RPM is at peak, then continue to lean until there is a 25-50 RPM drop. There is a warning that fuel consumption can be 10 percent higher if the first method is used instead of the recommended procedure. There is also a warning that not following this recommended procedure and leaving the mixture in the full rich position can increase fuel consumption as much as 40 percent and decrease flight endurance by as much as 70 minutes from what is published in the 75 percent power performance figures.

Since old operating habits can be deadly to pilots transitioning between aircraft with different operating procedures, pilots need to be aware that during stressful or emergency situations in the new aircraft, they may use the wrong procedures. In such situations, pilots must make sure they are using the correct procedure for the aircraft they are flying. Pilots must be particularly careful anytime they are making any changes involving the fuel system or the landing gear system.

SYSTEMS OVERLAP

Aircraft operating systems can also overlap and cause problems. This is particularly true of the electrical and hydraulic

systems involving the landing gear and control systems. This relationship is extremely important. In one incident, a pilot had a total electrical failure in an aircraft that had an electrically operated landing gear system. After the gear up landing, the pilot said he knew the gear down indicators would not work because they were electrically operated. He thought the gear was down because the manual indicator showed they were down after he had put the gear handle in the down position. When asked if he had lowered the gear manually, he said, "No." If this pilot had possessed more insight into the interrelationship between systems this incident might not have occurred.

We mentioned avionics systems. Fatal accidents have occurred because pilots set up their navigation/communication systems improperly. No more needs to be said.

LIMITATIONS, PERFORMANCE, AND WEIGHT AND BALANCE

These three areas are very closely interrelated. Operating at airspeeds where you get the best performance could be a limitation, since increasing or decreasing speed would decrease desired aircraft performance. An example of this is L/D max. This is where the lift to drag ratio is the greatest or the airspeed where you get the most lift for the least drag. Why is this important? This is the speed which would give the aircraft the greatest gliding distance in the event of a complete power failure. You would need this performance to reach a safe landing area. Changing speed would only reduce your chances of making the field.

Weight and performance are closely interrelated. Increasing weight reduces performance. This will cause an increased takeoff distance, reduce an aircraft's rate-of-climb capability, and cause the true airspeed to be less at a given power setting and density altitude. Although pilots should always compute the weight and balance and performance data for every flight, this information is especially important when transitioning to a new aircraft.

Aircraft speeds, the various "V Speeds," are also important for the safe operation of any aircraft. It is recommended pilots know the following V Speeds that apply to their particular aircraft:

- V_{so} Stalling speed or the minimum steady flight speed in the landing configuration
- V_{s1} Stalling speed or the minimum steady flight speed in a specified configuration
- V_r Rotation speed

V _{mc}	Minimum control speed with the critical engine inoperative (multi-engine aircraft)
1.3V _{so}	Recommended final approach speed in the landing configuration (if none specified in the aircraft's documentation)
V _x	Speed for the best angle of climb
V _{xse}	Speed for the best angle of climb (one engine inop in multi-engine aircraft)
V _y	Speed for the best rate of climb
V _{yse}	Speed for the best rate of climb (one engine inop in multi-engine aircraft)
V _{lo}	Maximum landing gear operating speed
V _{le}	Maximum landing gear extended speed
V _{fe}	Maximum flap extended speed
V _a	Design maneuvering speed
V _{ne}	Never exceed speed
L/D _{max}	Airspeed that gives you the maximum gliding distance over the ground with complete power failure

Obviously these are a lot of numbers to memorize, however it must be remembered what was said at the beginning of this article, a pilot must know how to operate his or her aircraft safely. Knowing V Speeds is part of knowing what to do not only when something goes wrong but also when things are going right. One way to remember these speeds is to write them on 3 x 5 inch cards and have them where they can easily be referred to just prior to specific flight operations. Many of these speeds are also marked on the instrument panel, some operating controls, and the airspeed indicator.

There are many other limitations that a pilot needs to know such as manifold pressure, RPM, engine oil temperature and pressure, cylinder head temperature, hydraulic pressure limits, volt and loadmeter readings, etc. Fortunately for most of us, the aircraft we fly normally have these marked with color-coded indicators. However, it is important to know where the needles normally point so that any change will be noticed.

NORMAL, ABNORMAL, AND EMERGENCY PROCEDURES

One of the best and safest ways to become familiar with these procedures is in a flight simulator designed for your particular make and model of aircraft. Since the majority of the smaller general aviation aircraft do not have simulators, there is another

way to become proficient in such aircraft at no cost when the actual aircraft is available and not in use. This is to just get into the aircraft with the owners manual and begin to familiarize yourself with the cockpit. This includes going over the checklists to familiarize yourself with the location of the knobs, switches, and handles in the cockpit, and the pattern that develops when running the checklist. Some flight training institutions require their students to pass what is known as a blindfold cockpit check which is literally just that. You have to memorize the location of each item in the cockpit then put on a blindfold and be able to touch each item called out by the check pilot without being able to look for it. If this seems a little extreme, think how invaluable this ability would be during a high workload situation under single-pilot operations. Envision yourself alone in the cockpit on a dark and stormy night on an instrument approach when the landing gear indicator does not indicate a normal down and locked position. It sure would be nice to know exactly where the landing gear motor and landing gear circuit breakers are so you could reach over and feel to see if they are popped instead of having to look for them which could break down your scan, or worse, possibly induce vertigo.

When using a static aircraft as a training device, you should run through all the checklists as many times as necessary to become thoroughly familiar with their content and the location of all of the controls and items contained in the list or lists. Do each item that can be safely done on a static aircraft. However, **DO NOT MOVE THE LANDING GEAR HANDLE AT ANY TIME DURING THIS TRAINING ACTIVITY.** Also, be aware that there may be other persons around the aircraft when you are operating such items as flaps and spoilers so you must use extreme caution when activating such devices. When applying power to any aircraft or starting any aircraft, you must always ensure the safety of others in the immediate area. You must never apply power when others are working on an aircraft without coordinating your actions with those working on the aircraft. The reverse is also true. When you are working on an aircraft, you should either lockout or mark those controls or switches that would endanger you if someone inadvertently activated them while you are working on the aircraft. This is particularly true when you are working on large aircraft where you may be out sight of someone in the cockpit.

CHECKLISTS

We have used the word "memorized" in this article several times; however, when it comes to checklists, they are not to be

memorized. A checklist is for checking that an item isn't forgotten. This brings up the rather controversial subject of how to use a checklist. This subject is especially controversial if a multi-pilot crew is involved and the pilots have different ways of doing a procedure. This potential conflict is why the aviation industry and FAA have spent so much time and money on teaching crews how to work together. Whether you are a single pilot or part of a multi-crew cockpit, the important thing to remember is to use a checklist in a way that insures you don't inadvertently skip an item.

We said checklists are not to be memorized. This is true for normal procedures. It is not necessarily true for all aircraft when it comes to emergency procedures. In many aircraft flight manuals, in the emergency procedures section, there are immediate action items that must be done if certain emergencies occur. These immediate action items obviously must be memorized and then followed up later with the checklist when circumstances permit. Some checklists are nice to memorize. Using the example of a night instrument approach when the gear doesn't indicate down and you need to lower it manually, it would be nice to know what the proper procedure is before you have to do it for real without ever having read the manual. This is why it is important for all pilots to periodically review their aircraft's operating and emergency procedures. Better yet, hire a CFI for some recurrent training. Remember to always use your checklist.

THE AIRCRAFT, AIRCRAFT PAPERWORK, AND RECORDS

Before you can have a safe flight you must have a safe pilot, a safe aircraft, and safe weather. To have a safe aircraft you must have an airworthy aircraft. An aircraft is considered airworthy when it conforms to its FAA-approved type certificate data and is in condition for safe operation. Conformity to the type certificate is considered attained, when the required and proper components are installed and they are consistent with the drawings, specifications, and other data that are part of the type certificate. Conformity would include applicable supplemental type certificates (STC's) and field-approved alterations, and airworthiness directives. "In condition for safe operation" refers to the condition of the aircraft with relation to wear and deterioration. If one or both of these conditions are not met, the aircraft is unairworthy.

So, who's responsible for ensuring an aircraft is airworthy and what do they check? The pilot in command (PIC) is responsible for ensuring the aircraft is safe before each flight. The aircraft owner or operator is primarily responsible for maintaining the air-

craft in an airworthy condition. Both share responsibility for ensuring the aircraft is safe for flight.

The following are some of the items a pilot should check before each flight.

FAR PART 91 PREFLIGHT CHECKS

1. Annual inspection—within 12 calendar months and signed off by an FAA-certificated airframe and powerplant mechanic with inspection authorization (IA).
2. 100 hour inspection—if required for the type of operation planned.
3. Airworthiness Directives (AD's)—all complied with (both one-time and recurrent).
4. Altimeter system and altitude reporting equipment tests and inspection—within 24 calendar months for IFR operations in controlled airspace.
5. Transponder test and inspection—within 24 calendar months.
6. ELT inspection—within 12 calendar months. Battery—not expired.
7. VOR operational check—within the last 30 days and the results logged (if used for IFR operations)

DOCUMENTATION—"ARROW"

1. Airworthiness Certificate
2. Registration Certificate
3. Radio station transmitter license issued by the FCC if a transmitter is installed
4. Operating limitations found in the Airplane Flight Manual or Owners Handbook with appropriate placards and markings
5. Weight and Balance Documentation

This list may not be all inclusive. The PIC is responsible for ensuring the flight complies with all of the appropriate FAR. The Airworthiness Certificate states in part "...this airworthiness certificate is effective as long as the maintenance, preventative maintenance and alterations are performed in accordance with Parts 21, 43, and 91 of the Federal Aviation Regulations, as appropriate, and the aircraft is registered in the United States." This statement means not only the above checklist items but all applicable regulations are required to be complied with for the airworthiness certificate to be effective.

To determine the aircraft is "in condition for safe operation" requires a good preflight by the pilot in accordance with the aircraft manufacturer's recommendations to determine "wear and deterioration" have not created any unsafe conditions.

AIRCRAFT CHECKOUT

What constitutes a good aircraft checkout? It depends on the complexity of the aircraft and the ability of the pilot being checked out as well as the ability of the pilot doing the checkout. What would be adequate in a single-engine, fixed-gear aircraft obviously would not be adequate for a complex single or twin and what is adequate in a recip twin would not be adequate in a turbine powered aircraft.

For small recip singles and light twins the following is one suggested checkout. Review the previous items discussed in this article—systems, limitations, procedures, cockpit arrangement, various load configurations, etc. Then review the standard flight training procedures that you will use to familiarize yourself with the aircraft's flight characteristics. One good guide is the FAA Practical Test Standards (PTS) appropriate to your rating. For example, if you are a commercial pilot, you would use the commercial PTS while conducting your checkout. At a minimum, the Private Pilot PTS is a good lesson and flight outline for a detailed aircraft checkout.

The following outline will help you become familiar with a new airplane.

1. A detailed preflight using a checklist.
2. Start, taxi and run-up.
3. Takeoff series and aborted takeoff practice.

4. Turns, climbs, and descents.
5. Flight at minimum controllable airspeed.
6. Stall series (appropriate to the aircraft). Remember to use clearing turns.
7. Steep turns.
8. Simulated emergencies (appropriate to the aircraft).
9. Landing series and go-arounds.
10. Shutdown and postflight.
11. Fueling procedures.
12. Discrepancy reporting procedures.
13. Appropriate aircraft endorsement if required such as a high performance or tailwheel aircraft endorsement—if needed (must be from an authorized flight instructor).

PILOT REQUIREMENTS

The above information has dealt mainly with the aircraft's requirements. We also need to mention the pilot's requirements. Pilots need to comply with the following requirements:

1. Pilot certificate—with appropriate ratings and in your personal possession.
2. Medical—current and appropriate for the type of flight to be conducted and in your personal possession (if required for the operation).
3. Flight review or its equivalent with appropriate logbook endorsement.
4. Meet the recent flight experience to be pilot in command (PIC) if carrying passengers. PIC's must meet the appropriate requirements of FAR § 61.57 which include:
 - a. A takeoff and landing requirement for any passenger

carrying flight such as the requirement for:

(1) Any aircraft: Three takeoffs and landings as the sole manipulator of the flight controls in an aircraft of the same category and class and, if a type rating is required, of the same type, within the preceding 90 days.

(2) Tailwheel aircraft—The required landings must be to a full stop.

(3) Night currency for night flights. The required three takeoffs and three landings must be made to a full stop in the same category and class aircraft to be used. These must be done during that period beginning one hour after sunset and ending one hour before sunrise (as published in the American Air Almanac).

b. Instrument currency for any IFR operation as PIC.

Unless the pilot has logged at least six hours of instrument time under actual or simulated IFR conditions, at least three of which were in flight in the category of aircraft involved, including at least six instrument approaches within the past six months, or passed an instrument competency check in the category of aircraft involved within the past six months. Glider pilots must have logged at least three hours of instrument time with at least half of that time in a glider or aircraft. If passengers are to be carried in a glider, the pilot must have logged at least three hours of instrument flight time in gliders.

This article is about how to transition to another aircraft, but the important thing to keep in mind is not just how we do something in aviation, but how well we do it. Have a safe flight.

Additional Reading:

Advisory Circular (AC) 20-5F, Plane Sense
AC 61-9B, Transition Courses for Complex Single Engine and Light, Twin-Engine Airplanes
AC 60-22, Aeronautical Decision Making
AC 61-84B, Role of Preflight Preparation

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