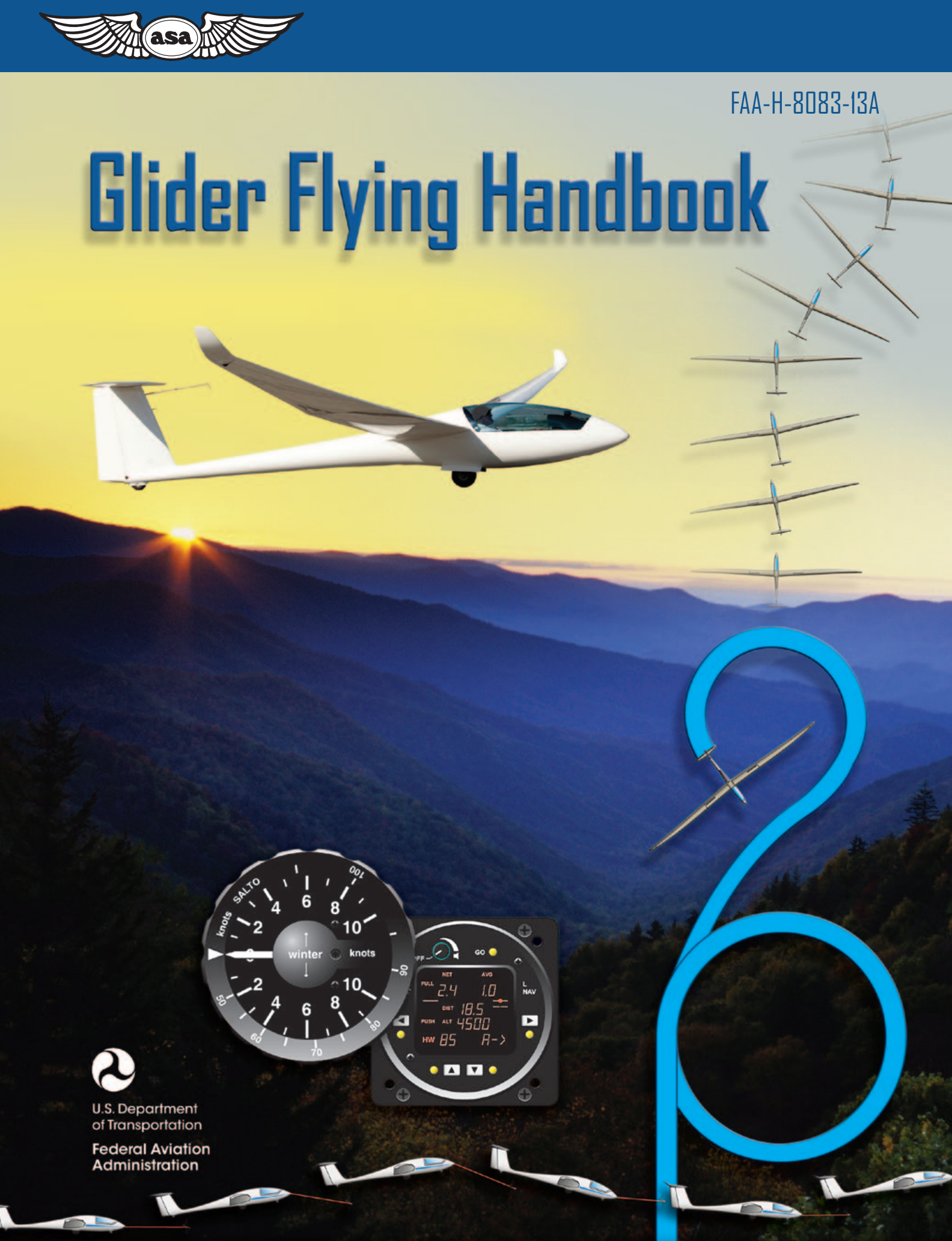
FAA-H-8083-13A

Glider Flying Handbook



U.S. Department
of Transportation
Federal Aviation
Administration

Glider Flying Handbook
2013
FAA-H-8083-13A

Aviation Supplies & Academics, Inc.
7005 132nd Place SE
Newcastle, Washington 98059-3153

ASA-8083-13A-PD
978-1-61954-105-4

Preface

The Glider Flying Handbook is designed as a technical manual for applicants who are preparing for glider category rating and for currently certificated glider pilots who wish to improve their knowledge. Certificated flight instructors will find this handbook a valuable training aid, since detailed coverage of aeronautical decision-making, components and systems, aerodynamics, flight instruments, performance limitations, ground operations, flight maneuvers, traffic patterns, emergencies, soaring weather, soaring techniques, and cross-country flight is included. Topics such as radio navigation and communication, use of flight information publications, and regulations are available in other Federal Aviation Administration (FAA) publications.

The discussion and explanations reflect the most commonly used practices and principles. Occasionally, the word "must" or similar language is used where the desired action is deemed critical. The use of such language is not intended to add to, interpret, or relieve a duty imposed by Title 14 of the Code of Federal Regulations (14 CFR). Persons working towards a glider rating are advised to review the references from the applicable practical test standards (FAA-G-8082-4, Sport Pilot and Flight Instructor with a Sport Pilot Rating Knowledge Test Guide, FAA-G-8082-5, Commercial Pilot Knowledge Test Guide, and FAA-G-8082-17, Recreational Pilot and Private Pilot Knowledge Test Guide). Resources for study include FAA-H-8083-25, Pilot's Handbook of Aeronautical Knowledge, FAA-H-8083-2, Risk Management Handbook, and Advisory Circular (AC) 00-6, Aviation Weather For Pilots and Flight Operations Personnel, AC 00-45, Aviation Weather Services, as these documents contain basic material not duplicated herein. All beginning applicants should refer to FAA-H-8083-25, Pilot's Handbook of Aeronautical Knowledge, for study and basic library reference.

It is essential for persons using this handbook to become familiar with and apply the pertinent parts of 14 CFR and the Aeronautical Information Manual (AIM). The AIM is available online at www.faa.gov. The current Flight Standards Service airman training and testing material and learning statements for all airman certificates and ratings can be obtained from www.faa.gov.

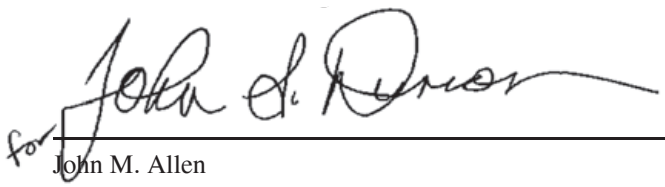
This handbook supersedes FAA-H-8083-13, Glider Flying Handbook, dated 2003. Always select the latest edition of any publication and check the website for errata pages and listing of changes to FAA educational publications developed by the FAA's Airman Testing Standards Branch, AFS-630.

This handbook is available for download, in PDF format, from www.faa.gov.

This handbook is published by the United States Department of Transportation, Federal Aviation Administration, Airman Testing Standards Branch, AFS-630, P.O. Box 25082, Oklahoma City, OK 73125.

Comments regarding this publication should be sent, in email form, to the following address:

AFS630comments@faa.gov



John M. Allen
Director, Flight Standards Service

Table of Contents

Chapter 1

Gliders and Sailplanes

Introduction

Welcome to the world of soaring. Whether it has been a lifelong dream or a new interest, the pleasure of flying is truly addictive and exhilarating. The intellectual challenge combined with the quiet and beauty of flying high above the earth are two of the many reasons that people both young and old get hooked on flying gliders. If contemplating learning more about the sport, an introductory flight absolutely helps make the decision. Soaring gracefully through the air, along with the meditative silence that surrounds you, is refreshing and exciting. Organizations such as the Soaring Society of America (SSA) have developed excellent programs not only to track a pilot's learning progression, but also issue badges for flight and knowledge accomplishments. Glider clubs are located all over the country and offer great flight training schools and pilot camaraderie.

The Glider Flying Handbook is designed to aid pilots in achieving their goals in aviation and to provide the knowledge and practical information needed to attain private, commercial, and flight instructor category ratings for gliders. This handbook, in conjunction with the Pilot's Handbook of Aeronautical Knowledge, FAA-H-8083-25 (as revised), is a source of basic knowledge for certification as a glider pilot and instructor. There are numerous other commercial sources available to the pilot for reference that should be obtained for additional information.

Gliders—The Early Years

The fantasy of flight led people to dream up intricate designs in an attempt to imitate the flight of birds. Leonardo da Vinci sketched a vision of flying machines in his 15th century manuscripts. His work consisted of a number of wing designs including a human-powered ornithopter, the name derived from the Greek word for bird. Centuries later, when others began to experiment with his designs, it became apparent that the human body could not sustain flight by flapping wings like birds. *[Figure 1-1]* The dream of human flight continued to capture the imagination of many, but it was not until 1799 when Sir George Cayley, a Baronet in Yorkshire, England, conceived a craft with stationary wings to provide lift, flappers to provide thrust, and a movable tail to provide control.

Otto Lilienthal was a German pioneer of human flight who became known as the Glider King. *[Figure 1-2]* He was the first person to make well-documented, repeated, successful gliding flights beginning in 1891. *[Figure 1-3]* He followed an experimental approach established earlier by Sir George Cayley. Newspapers and magazines published photographs of Lilienthal gliding, favorably influencing public and scientific opinion about the possibility of flying machines becoming practical.

Figure 1-2. *Otto Lilienthal (May 23, 1848–August 10, 1896) was a German pioneer of human aviation.*

By the early 1900s, the famed Wright Brothers were experimenting with gliders and gliding flight in the hills

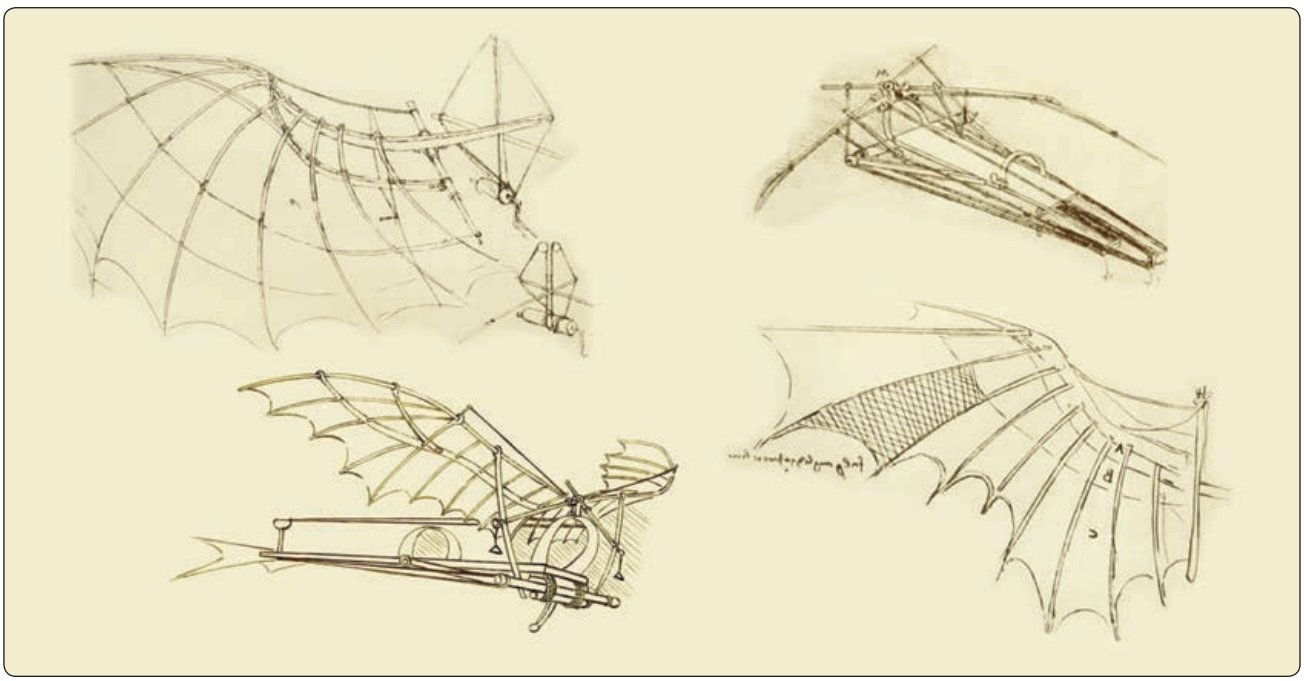


Figure 1-1. *A human-powered ornithopter is virtually incapable of flight due to its poor strength-to-weight ratio.*

Figure 1-3. *Otto Lilienthal in flight.*

of Kitty Hawk, North Carolina. *[Figure 1-4]* The Wrights developed a series of gliders while experimenting with aerodynamics, which was crucial to developing a workable control system. Many historians, and most importantly the Wrights themselves, pointed out that their game plan was to learn flight control and become pilots specifically by soaring, whereas all the other experimenters rushed to add power without refining flight control. By 1903, Orville and Wilbur Wright had achieved powered flight of just over a minute by putting an engine on their best glider design.

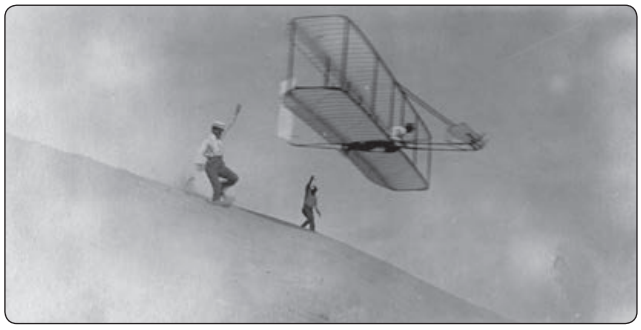


Figure 1-4. *Orville Wright (left) and Dan Tate (right) launching the Wright 1902 glider off the east slope of the Big Hill, Kill Devil Hills, North Carolina on October 17, 1902. Wilbur Wright is flying the glider.*

By 1906, the sport of gliding was progressing rapidly. An American glider meet was sponsored by the Aero Club of America on Long Island, New York. By 1911, Orville Wright had set a world duration record of flying his motorless craft for 9 minutes and 45 seconds.

By 1920, the sport of soaring was coming into its own. Glider design was spurred on by developments in Germany where the World War I Treaty of Versailles banned flying power aircraft. New forms of lift were discovered that made it possible to gain altitude and travel distances using these previously unknown atmospheric resources. In 1921, Dr. Wolfgang Klemperer broke the Wright Brothers 1911 soaring duration record with a flight of 13 minutes using ridge lift. In 1928, Austrian Robert Kronfeld proved that thermal lift could be used by a sailplane to gain altitude by making a short out and return flight. In 1929, the National Glider Association was founded in Detroit, Michigan; by 1930, the first USA National Glider Contest was held in Elmira, New York. In 1937, the first World Championships were held at the Wasserkuppe in Germany.

By the 1950s, soaring was developing rapidly with the first American, Dr. Paul MacCready, Jr., taking part in a World Soaring Championships held in Sweden. Subsequently, Dr. MacCready went on to become the first American to win a World Soaring Championship in 1956 in France.

The period of the 1960s and 1980s found soaring growing rapidly. During this period, there was also a revival of hang gliders and ultralight aircraft as new materials and a better understanding of low-speed aerodynamics made new designs possible.

By the late 1990s, aviation had become commonplace with jet travel becoming critical to the world economy. Soaring had grown into a diverse and interesting sport. Modern high performance gliders are made from composite materials and take advantage of highly refined aerodynamics and control systems. Today, soaring pilots use sophisticated instrumentation, including global positioning system (GPS) and altitude information (variometer) integrated into electronic glide computers to go farther, faster, and higher than ever before.

Glider or Sailplane?

The Federal Aviation Administration (FAA) defines a glider as a heavier-than-air aircraft that is supported in flight by the dynamic reaction of the air against its lifting surfaces, and whose free flight does not depend principally on an engine. *[Figure 1-5]* The term "glider" is used to designate the rating

Figure 1-5. *A Schleicher ASK 21 glider.*

that can be placed on a pilot certificate once a person successfully completes required glider knowledge and practical tests.

Another widely accepted term used in the industry is sailplane. A sailplane is a glider (heavier-than-air fixed-wing aircraft) designed to fly efficiently and gain altitude solely from natural forces, such as thermals and ridge waves. *[Figure 1-6]* Older gliders and those used by the military were not generally designed to gain altitude in lifting conditions, whereas modern day sailplanes are designed to gain altitude in various conditions of lift. Some sailplanes are equipped with sustaining engines to enable level flight even in light sink, or areas of descending air flow. More sophisticated sailplanes may have engines powerful enough to allow takeoffs and climbs to soaring altitudes. In both cases, the powerplants and propellers are designed to be stopped in flight and retracted into the body of the sailplane to retain the high efficiency necessary for nonpowered flight.

Figure 1-6. *A sailplane is a glider designed to fly efficienctly and gain altitude solely from natural forces, such as thermals and ridge waves.*

Gliding, that is flying a glider or sailplane, is relatively easy to learn, but soaring, which is gaining altitude and traveling without power, is much more difficult and immensely satisfying when accomplished. Soaring refers to the sport of flying sailplanes, which usually includes traveling long distances and remaining aloft for extended periods of time. Gliders were designed and built to provide short flights off a hill down to a landing area. Since their wings provided relatively low lift and high drag, these simple gliders were generally unsuitable for sustained flight using atmospheric lifting forces. Both terms are acceptable and are synonymous. Early gliders were easy and inexpensive to build, and they played an important role in flight training. The most well-known example today of a glider is the space shuttle, which literally glides back to earth. The space shuttle, like gliders that remain closer to the earth, cannot sustain flight for long periods of time.

Self-launching gliders are equipped with engines; with the engine shut down, they display the same flight characteristics as nonpowered gliders. *[Figure 1-7]* The engine allows them to be launched under their own power. Once aloft, pilots of self-launching gliders can shut down the engine and fly with the power off. The additional training and procedures required to earn a self-launch endorsement are covered later in this handbook.

Figure 1-7. *An ASH 26 E self-launching sailplane with the propeller extended.*

Glider Pilot Schools

Most airports or glider bases have some type of pilot training available, either through FAA-approved pilot schools or individual FAA-certificated flight instructors. FAA-approved glider schools usually provide a wide variety of training aids, special facilities, and greater flexibility in scheduling. A number of colleges and universities also provide glider pilot training as a part of their overall pilot training curricula. However, most glider training is conducted by individual flight instructors through a membership in a glider club. Also, there are several commercial glider companies located around the United States offering flight training, sightseeing glider rides, and glider towing services.

Choosing the right facility or instructor for your glider training should be both exciting and educational. Many factors need to be considered when choosing the right school, such as location, type of certification, part- or full-time training, and cost. The quality of training received should be the most important factor. Before interviewing schools, potential student pilots should be educated on the types of training curriculums that are available. Pilot training is conducted in accordance with one of two regulatory categories: Title 14 of the Code of Federal Regulations (14 CFR) part 141 or 14 CFR part 61. Students can receive exceptional flight training under either part 141 or 61 training programs, as both have the same teaching and testing requirements. What differs is the way you are taught in order to meet those same requirements.

14 CFR Part 141 Pilot Schools

Pilot schools that are certificated under 14 CFR part 141 provide a more structured training program with a standardized FAA-approved training syllabus. This ensures that all necessary skills are taught in a specific order through approved lesson plans. Under part 141, students are also required to complete a specific number of hours of formal ground instruction either in a classroom or one on one with an FAA-certificated flight instructor. Students are also required to pass the FAA knowledge and practical tests. In order to obtain approval and maintain their part 141 certification, pilot schools must adhere to several FAA regulations.

Because part 141 pilot schools must adhere to the approved training regiment, their students are allowed to complete the pilot certificate or rating in fewer flight training hours than required by part 61. However, most students generally exceed the reduced part 141 flight training hour requirements in order to meet the proficiency standards to pass the practical test.

14 CFR Part 61 Instruction

Pilot training conducted under 14 CFR part 61 offers a somewhat more flexible and less structured training program than that conducted under part 141. A part 61 training syllabus is not subject to FAA approval; therefore, flight instructors have the flexibility to rearrange lesson plans to suit the individual needs of their students. However, it is important to understand that flight instructors must adhere to the requirements of part 61 and train their students to the standards of part 61.

Training under part 61 does not require the student to complete a formal ground school. Instead, students have the following three options: (1) attend a ground school course, (2) complete a home-study program, or (3) hire a certificated flight or ground instructor to teach and review any materials that they choose. Regardless of which option a student chooses to take, all students are required to pass the FAA knowledge and practical tests for the pilot certificate or rating for which they are applying. The requirements for pilot training under part 61 are less structured than those under part 141, and part 61 may require more flight training hours to obtain a pilot certificate or rating than part 141.

Most glider training programs can be found on the SSA website at www.ssa.org. Once you choose a general location, make a checklist of things to look for in a training organization. By talking to pilots, visiting the facility, and reading articles in pilot magazines, a checklist can be made and used to evaluate your options. Your choice might depend on whether you are planning to obtain a sport or private pilot certificate or pursuing a higher pilot certificate or a flight instructor certificate toward becoming a professional glider pilot. The quality of training is very important and should be the first priority when choosing a course of training. Prior to making a final decision, visit the facility being considered and talk with management, instructors, and both current and former students. Evaluate all training requirements using a checklist, and then take some time to think things over before making a decision.

After deciding where to learn to fly and making the necessary arrangements, training can begin. An important fact: ground and flight training should be obtained as regularly and frequently as possible. This assures maximum retention of instruction and the achievement of proficiency for which every pilot should strive.

Glider Certificate Eligibility Requirements

To be eligible to fly a glider solo, an individual must be at least 14 years of age and demonstrate satisfactory aeronautical knowledge on a test developed by an instructor. A student must also have received and logged ground and flight training for the maneuvers and procedures in 14 CFR part 61 that are appropriate to the make and model of aircraft to be flown. A student pilot must demonstrate satisfactory proficiency and safety. Only after all of these requirements are met can an instructor endorse a student's certificate and logbook for solo flight.

To be eligible for a private pilot certificate with a glider rating, an individual must be at least 16 years of age, complete the specific training and flight time requirements described in 14 CFR part 61, pass a knowledge test, and successfully complete a practical test.

To be eligible for a commercial or flight instructor glider certificate, an individual must be 18 years of age, complete the specific training requirements described in 14 CFR part 61, pass the required knowledge tests, and pass another practical test. If currently a pilot for a powered aircraft is adding a glider category rating on that certificate, the pilot is exempt from the knowledge test but must satisfactorily complete the practical test. Certificated glider pilots are not required to hold an airman medical certificate to operate a glider. However, they must not have any medical deficiencies.

The FAA Practical Test Standards (PTS) establish the standards for the knowledge and skills necessary for the issuance of a pilot certificate. It is important to reference the PTS, FAA Advisory Circular (AC) 60-22, Aeronautical Decision Making, Pilots Handbook of Aeronautical Knowledge (FAA-H-8083-25), and the Risk Management Handbook (FAA-H-8083-2) to understand the knowledge, skills, and experience required to obtain a pilot certificate to

fly a glider. For more information on the certification of the gliders themselves, refer to 14 CFR part 21, the European Aviation Safety Agency (EASA) Certification Specifications (CS) 22.221, and the Weight and Balance Handbook (FAA-H-8083-1).

Common Glider Concepts

Terminology

There are a number of terms used in gliding that all glider pilots should be familiar with. The list is not comprehensive, but includes the following:

- Knot—one nautical mile per hour (NMPH). A nautical mile is 6,076.115 feet as opposed to 5,280 feet in a statute mile. Rounded that is 6,000 feet, which divided by 60 minutes equals 100 feet per minute (fpm). Hence, this gives 1 on a variometer, which means one knot per hour or approximately 100 fpm. A 4-knot thermal lifts the glider at 400 fpm.
- Lift—measured in knots, rising air lifting the glider higher.
- Sink—falling air that forces the glider to lose height and is measured in knots.
- Attitude—the orientation of an aircraft in the air with respect to the horizon. If the aircraft is diving, then it is said to have a "nose-down attitude about its lateral axes." Attitude can also be a roll or bank as referenced to the longitudinal axis and pitch up or down as referenced to lateral axis.
- Pitch—the up and down movement around the lateral axis for pitch. Increasing the pitch lifts the nose and drops the tail. Decreasing the pitch drops the nose and lifts the tail.
- Roll—movement around a line between the nose and tail longitudinal axes. Rolling right drops the right wing while lifting the left wing.
- Yaw—a turning motion in which the nose of the aircraft moves to the right or left about its vertical axis.
- Cable—steel wire used to connect the glider to the winch. It is approximately 5mm wide and should be avoided at all times until after the correct training for safe handling. There are some winch operations using composite fiber cable that is stronger and lighter than steel.
- Strop—a special part of the winch cable that is designed to be handled. The strop has the tost rings that are attached to the glider.
- Weak link—a safety device in the winch cable or tow line. They come in various strengths (indicated by their color) and the correct one must be used with a given glider.
- Elevator—a moveable section in the tailplane (the small wing at the back of the glider) that effectively controls whether the glider climbs or dives in flight.
- Thermal—a bubble or column of warm rising air. Pilots try to find these columns of rising air and stay within them to gain altitude.

Converting Metric Distance to Feet

A glider pilot must also be able to convert distance in meters to distance in feet, using the following conversion:

1 meter = 3.2808 feet

Multiply the number of meters by 3.2808

To convert kilometers to nautical miles and nautical miles to kilometers or statute miles, use the following:

1 nautical mile (NM) = 1.852 kilometers (km)
1 nautical mile (NM) = 1.151 statute miles (SM)
1 km = 0.53996 NM

Glider Flying Handbook

FAA-H-8083-13A • 2013

U.S. Department
of Transportation

**Federal Aviation
Administration**

This is the FAA's primary technical manual for the required aeronautical knowledge necessary to operate a glider. It is essential reading for applicants preparing for the exams for private, commercial, or flight instructor pilot certificates with a glider rating, as well as for currently certificated glider pilots who wish to improve their knowledge. Flight instructors will find this handbook a valuable training aid, since it includes detailed coverage of aeronautical decision making, components and systems, aerodynamics, flight instruments, performance limitations, ground operations, flight maneuvers, traffic patterns, emergencies, soaring weather, soaring techniques, and cross-country flight.

In addition to a basic introduction to soaring and the associated glider certificate eligibility requirements and regulations, readers will find information on towing, human factors, and an appendix with the Soaring Safety Foundation (SSF) Safety Advisory 00-1, "Glider Critical Assembly Procedures," which covers ensuring aircraft airworthiness. Illustrated throughout with detailed, full-color drawings and photographs; includes comprehensive glossary and index.

Reprinted by ASA

Aviation Supplies & Academics, Inc.
7005 132nd Place SE
Newcastle, Washington 98059
www.asa2fly.com | 1-800-ASA-2-FLY