Chapter 2: Components & Systems

Introduction

Glider Design

Glider airframes include a fuselage, wings, and empennage or tail section. [*Figure 2-1*]

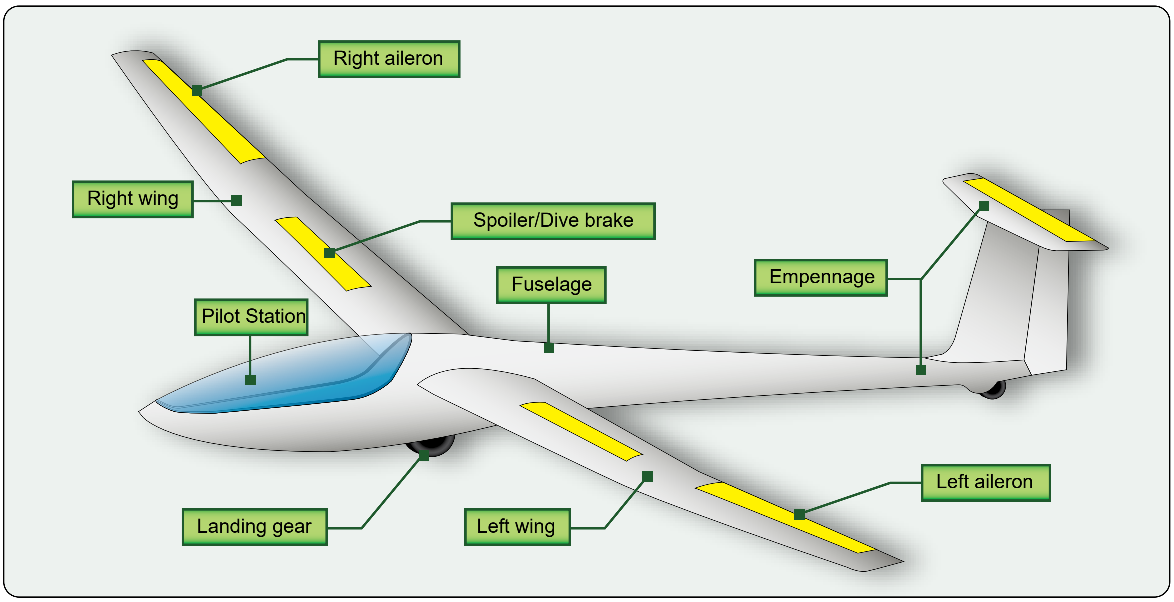

Figure 2-1. *Components of a glider.*

The Fuselage

The fuselage contains the controls for the glider, as well as a seat for each occupant. The wings and empennage attach to the fuselage. Manufacturers typically use composites, fiberglass, or carbon fiber, however in the past manufacturers used wood, fabric over steel tubing, aluminum, or a combination of these materials to build a fuselage.

Introduction

When air flows over the wings of a glider, the wings produce lift that allows the aircraft to stay aloft. Glider wing designs produce maximum lift with minimum drag.

Glider wings incorporate several components that help the pilot maintain the attitude of the glider and control lift and drag. These include ailerons and other lift and drag devices.

Ailerons

The ailerons attach to the outboard trailing edge of each wing. When the pilot moves the aileron control to the right of center, the right aileron deflects upward [*Figure 2-2*] and the left aileron deflects downward. In flight and with air flowing over the wings, these deflections result in increased lift on the left wing and decreased lift on the right wing. The increased lift on the left wing and decreased lift on the right wing apply a force to roll the glider to the right. Moving the aileron control to the left of center deflects the right aileron down and the left aileron up. This applies a force to roll the glider to the left.

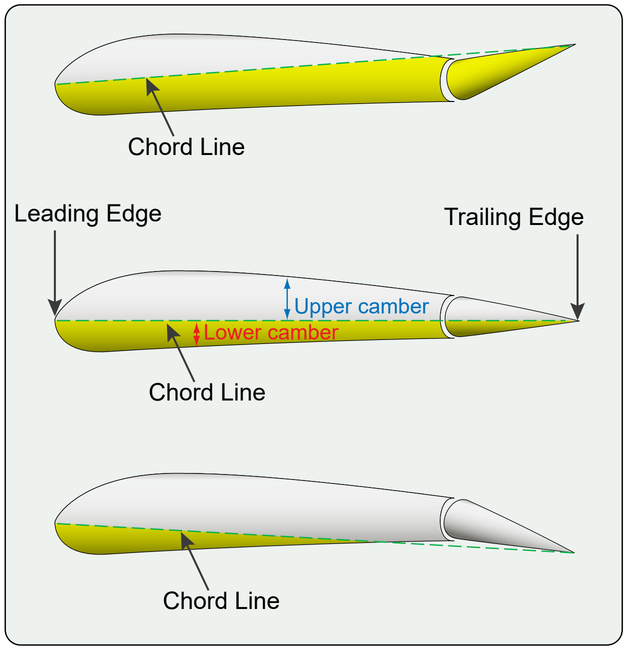

Figure 2-2. *The ailerons change the camber or curvature of the wing and increase or decrease lift.*

Lift/Drag Devices

Gliders may use other devices that modify the lift/drag of the wing. These high drag devices include spoilers, dive brakes, and flaps. [*Figure 2-3*] Spoilers extend from the upper surface of the wings, alter the airflow, and cause the glider to descend more rapidly. Dive brakes extend from both the upper and lower surfaces of the wing and increase drag. Some high-performance gliders have dive brake speed limitations to prevent structural damage.

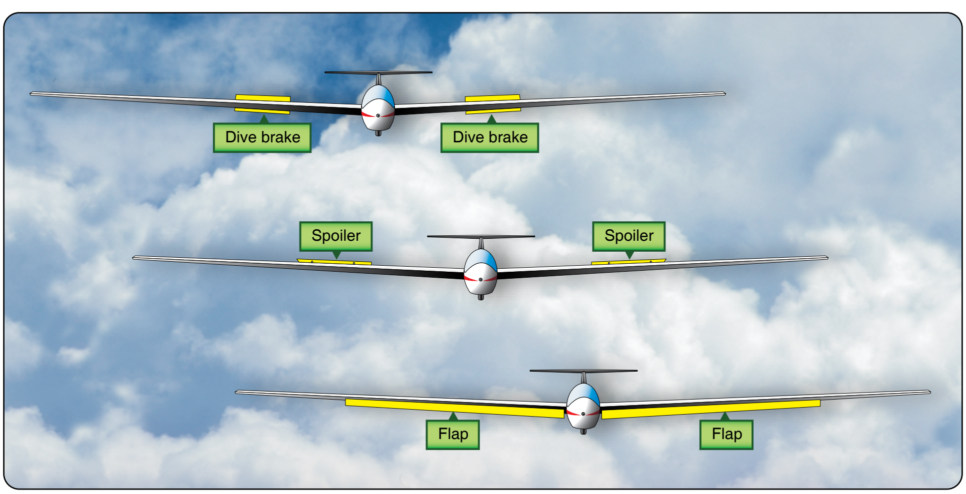

Figure 2-3. *Types of lift/drag devices.*

Some gliders have flaps installed on the trailing edge of each wing inboard of the ailerons, which can change lift, drag, and descent rate. The pilot can generally set flaps in three different positions, which are trail, down, or negative. [*Figure 2-4*] When the pilot sets the flaps to deflect downward in flight, the wing produces more lift and drag. On the other hand, a negative flap position results in reduced lift and drag.

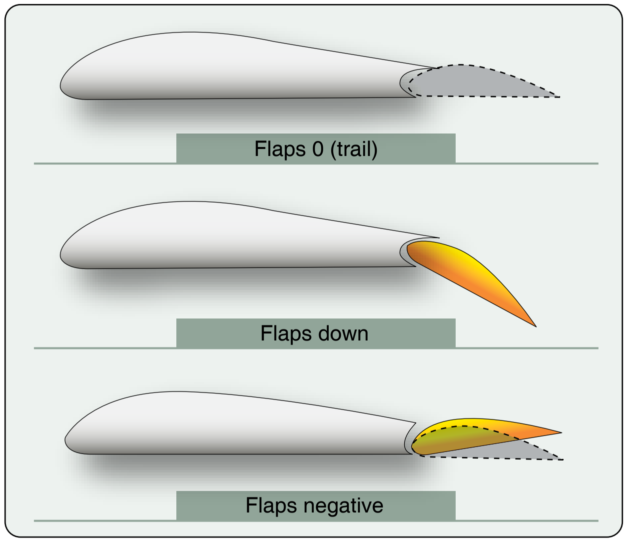

Figure 2-4. *Flap positions.*

Empennage

The empennage includes the entire tail section, consisting of the fixed surfaces, such as the horizontal stabilizer and vertical fin, and movable surfaces, such as the elevator or stabilator, rudder, and any trim tabs. The two fixed surfaces act like the feathers on an arrow to steady the glider and help maintain a straight path through the air. [*Figure 2-5*]

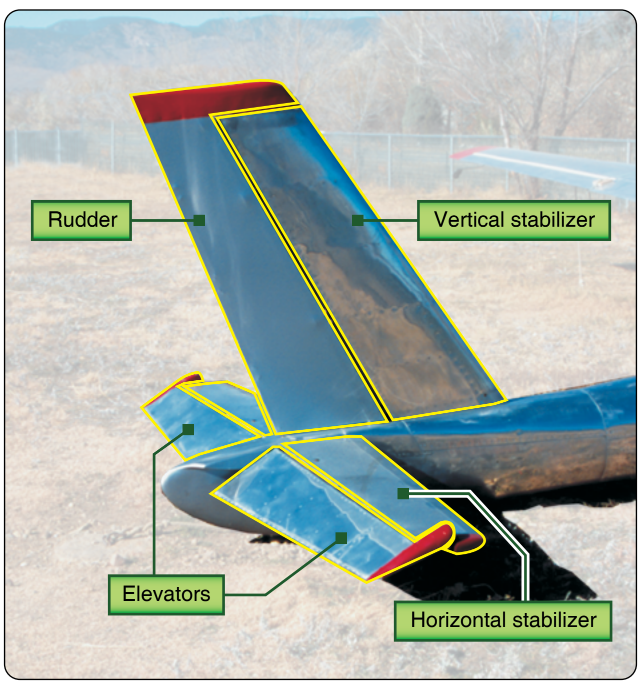

Figure 2-5. *Empennage components.*

The rudder attaches to the back of the vertical stabilizer, and the pilot deflects the rudder using foot pedals. The rudder controls yaw and turn coordination during flight.

During straight-and-level flight, pilot-controlled deflection of the elevator applies a force to move the glider's nose up and down relative to the horizon. Raising the nose results in lower airspeed while lowering the nose increases airspeed. Instead of a horizontal stabilizer and elevator, some gliders use a stabilator, where the entire horizontal tail surface pivots up and down on a central hinge point. Pilots refer to the movement of the elevator or stabilator as controlling the pitch attitude of the glider.

When the pilot deflects the pitch controls from the neutral position, the airflow pushes back against the controls. This opposing force provides feedback to the pilot but also adds to the pilot's workload. The pilot may relieve the elevator control pressure using elevator trim. A common trim system consists of a small, pilot-controlled adjustable tab on the trailing edge of the elevator. [*Figure 2-6*] Trim tabs come in servo and anti-servo designs. [*Figure 2-7*] A servo tab relieves pressure. The pilot can adjust an anti-servo tab, usually installed on stabilators, to relieve pressure, but it also self-adjusts to increase opposing pressure when the pilot increases stabilator displacement.

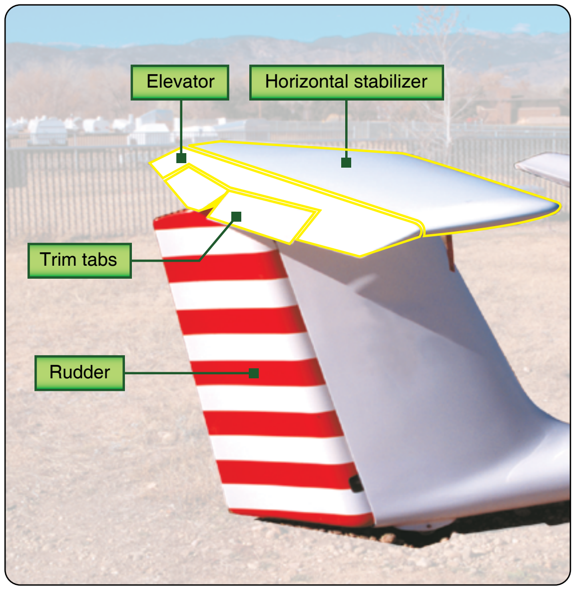

Figure 2-6. *Additional empennage components.*

Figure 2-7. *An anti-servo tab.*

Glider designs with a conventional tail incorporate the horizontal stabilizer mounted at the bottom of the vertical stabilizer. T-tail gliders have the horizontal stabilizer mounted on the top of the vertical stabilizer forming a "T" shape. V-tails have two tail surfaces mounted to form a "V" that combines elevator and rudder movements.

Towhook Devices

Gliders that launch using a tow have an approved towhook. For an aerotow, the crew normally connects the tow line to a towhook located on or just under the nose of the glider. For a tow using a winch or ground vehicle, the crew attaches the tow line to a towhook positioned below the glider center of gravity (CG)—the point where the glider would balance on the ground if lifted from above or below that position. [*Figure 2-8*]. Both towhook designs allow for quick release of the rope or cable when the glider pilot pulls the release handle. An aerotow launch of a glider using a specific towhook may only occur if the Glider Flight Manual/Pilot's Operating Handbook approves the procedure.

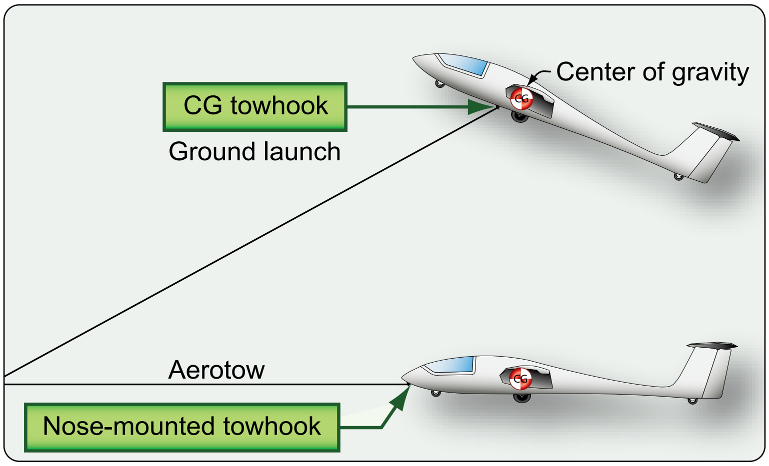

Figure 2-8. *Tow hook locations.*

Powerplant

While tow planes provide the most common means to launch a glider in the United States, self-launching gliders with built-in engines have become more commonplace.

Self-Launching Gliders

There are two types of self-launching gliders: touring motor gliders and high-performance self-launching gliders.

Touring Motor Gliders

Touring motor gliders have a nose-mounted engine and a full feathering propeller. [*Figure 2-9*] Although touring motor gliders have some basic airplane characteristics, they are certified in the glider category.

Figure 2-9. *A Grob G109B touring motor glider.*

High-Performance Gliders

High-performance self-launching gliders have engines that retract into the fuselage for minimal drag. [*Figure 2-10*] The propeller may fold, or simply align with the engine. This configuration preserves a smooth low drag configuration.

Figure 2-10. *A DG-808B 18-meter high-performance glider in self-launch.*

Gliders with Sustainer Engines

Some gliders have sustainer engines powered by either electricity or gasoline. A pilot can use a sustainer engine to remain aloft; however, sustainer engines do not provide sufficient power to launch the glider and may not have enough power to compensate for sinking air. [*Figure 2-11*]

Figure 2-11. *A Schleicher ASG-29 E with gasoline sustainer engine mast extended.*

Landing Gear

A glider landing gear system usually includes a main wheel. Gliders designed for high speed and low drag often feature a retractable main landing gear. Other components may include a front skid or wheel, a tail wheel or skid, or wing tip wheels or skid plates. [*Figure 2-12*]

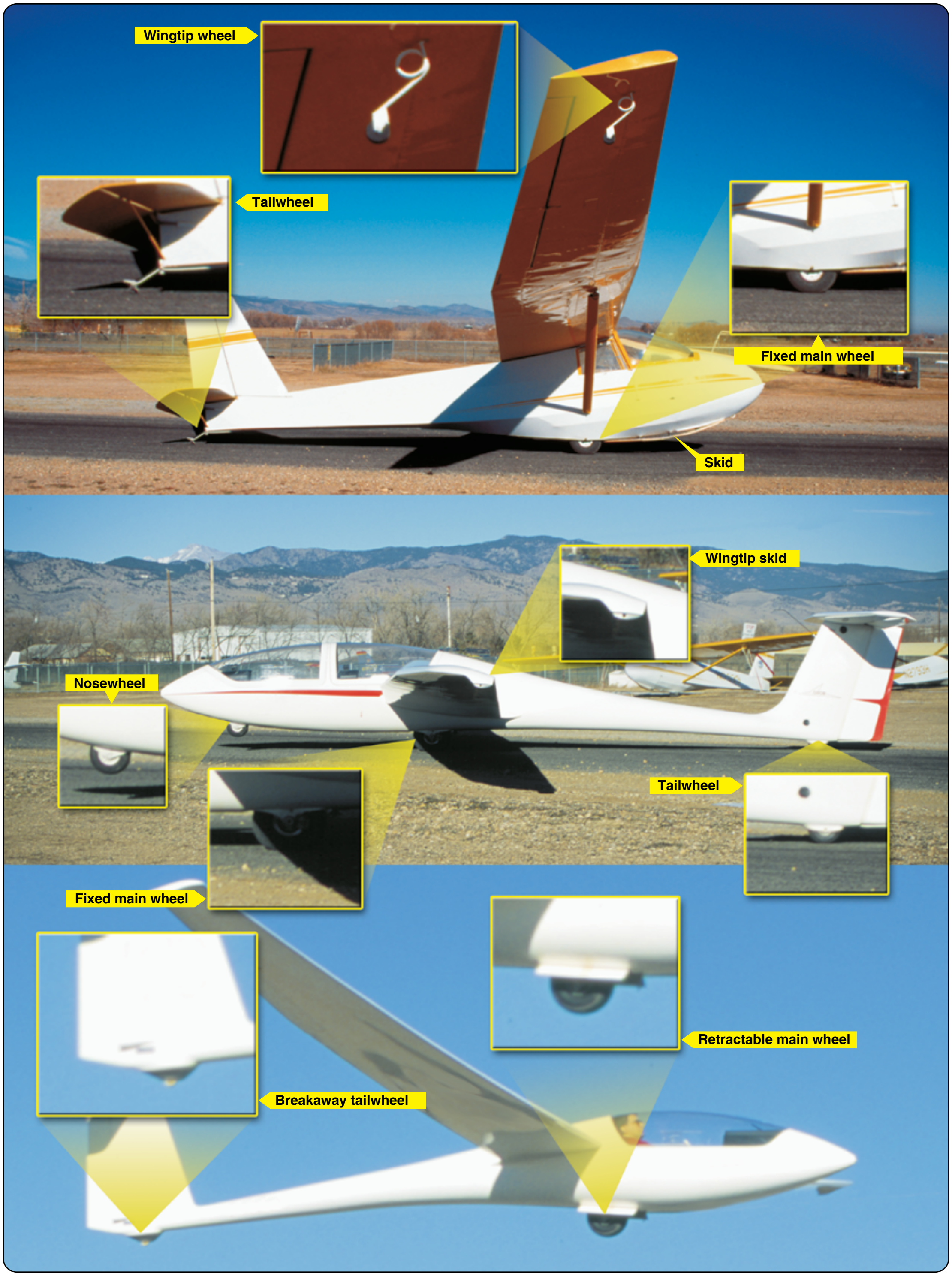

Figure 2-12. *Landing gear wheels on a glider.*

Almost all high-performance gliders have retractable landing gear, so pilots should include landing gear down in their prelanding checklist. Most landing gear handles are on the right side of the pilot station. However, a few models have gear handles on the left side, and pilots should use caution when reaching for a gear handle on the left to make sure it controls the gear and not flaps or airbrakes. A common error includes neglecting to retract the landing gear after takeoff, and then mistakenly retracting it as part of the prelanding checklist.

Some high-performance gliders have only one center of gravity (CG) tow hook either ahead of the landing gear or in the landing gear well. With a CG hook within the landing gear well, retracting the gear on tow interferes with the tow line. Even if the glider has a nose hook, retracting the gear should wait. A CG hook, as compared to a nose hook, makes a crosswind takeoff more difficult since the glider can weathervane into the wind more easily. In addition, a CG hook makes the glider more susceptible to kiting (climbing above the tow plane) on takeoff, which threatens the safety of the tow pilot.

Wheel Brakes

Early gliders often relied on friction between the nose skid and the ground to come to a stop. Later models use a wheel brake mounted on the main landing gear wheel, which helps the glider slow down or stop after touchdown. Modern gliders commonly use a hydraulic disk brake, which provides substantial braking capability.

Chapter Summary

Although gliders come in an array of shapes and sizes, most gliders share basic design features. These include a fuselage, wings and components, lift/drag devices, and empennage. Depending on the launch method used, a glider may have a towhook or an engine.