Glider Flying Handbook

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Figure 2-5. *The Schempp-Hirth Nimbus-4 is a family of high-performance Fédération Aéronautique Internationale (FAI) open class gliders.*

Figure 2-6. *The DG Flugzeugbau DG-1000 of the two-seater class.*

7. World class—the FAI Gliding Commission, which is part of the FAI and an associated body called Organization Scientifique et Technique du Vol à Voile (OSTIV), announced a competition in 1989 for a low-cost glider that had moderate performance, was easy to assemble and handle, and was safe for low-hours pilots to fly. The winning design was announced in 1993 as the Warsaw Polytechnic PW-5. This allows competitions to be run with only one type of glider.

Glider airframes are designed with a fuselage, wings, and empennage or tail section. Self-launching gliders are equipped with an engine that enables them to launch without assistance and return to an airport under engine power if soaring conditions deteriorate.

The Fuselage

The fuselage is the portion of the airframe to which the wings and empennage are attached. The fuselage houses the cockpit and contains the controls for the glider, as well as a seat for each occupant. Glider fuselages can be formed from wood, fabric over steel tubing, aluminum, fiberglass, Kevlar® or other composites, or a combination of these materials. *[Figure 2-7]*

Wings and Components

Glider wings incorporate several components that help the pilot maintain the attitude of the glider and control lift and drag. These include ailerons and lift and drag devices, such as spoilers, dive brakes, and flaps. Glider wings vary in size and span from 12.2 meters (40 feet) to 30 meter (101.38 feet).

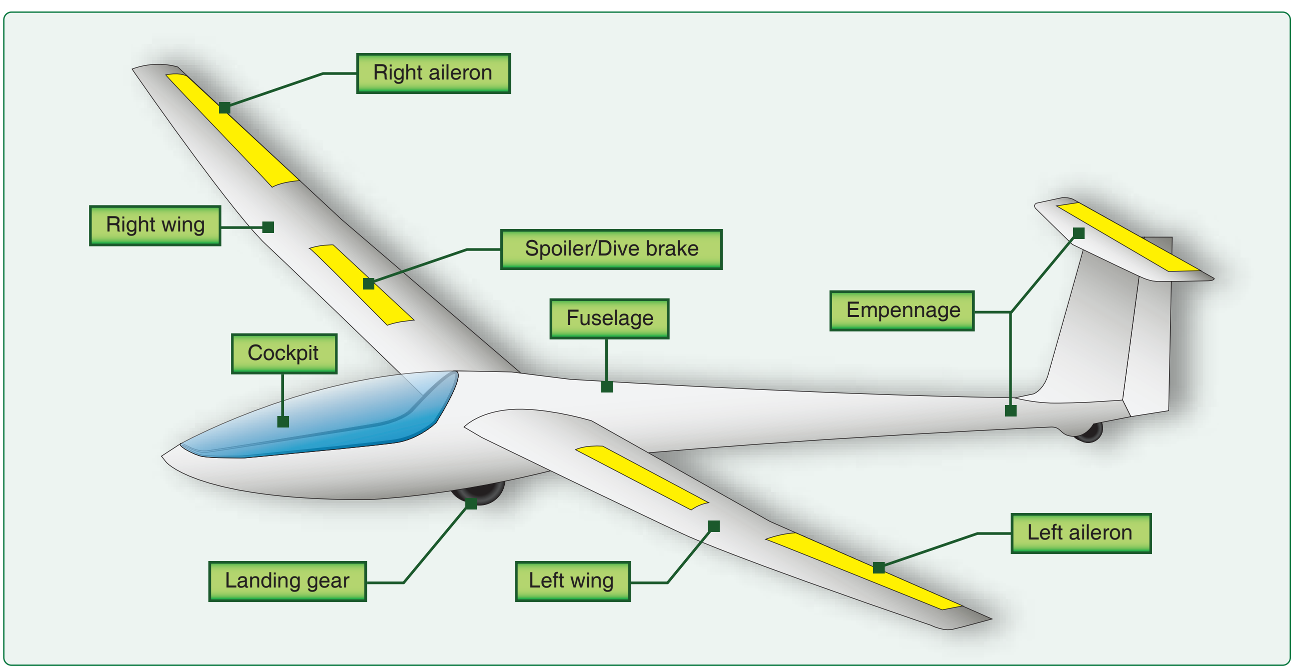

Figure 2-7. *Components of a glider.*

A wing may consist of a single piece attached to the fuselage to as many as four pieces (on one side).

The ailerons control movement around the longitudinal axis, known as roll. The ailerons are attached to the outboard trailing edge of each wing and move in opposite directions.

Moving the aileron controls with the control stick to the right causes the right aileron to deflect upward and the left aileron to deflect downward. The upward deflection of the right aileron decreases the effective camber (curvature of the wing surface), resulting in decreased lift on the right wing. *[Figure 2-8]* The corresponding downward deflection of the left aileron increases the effective camber, resulting in increased lift on the left wing. Thus, the increased lift on the left wing and decreased lift on the right wing causes the glider to roll to the right.

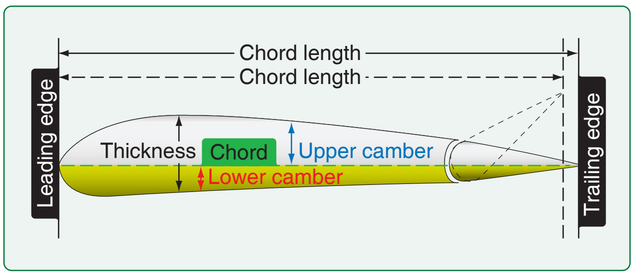

Figure 2-8. *The wing camber remains the same physically, but the ailerons change the "effective" camber of the wing and increase or decrease lift to change lift vectors to affect turns.*

Lift/Drag Devices

Gliders are equipped with devices that modify the lift/drag of the wing. These high drag devices include spoilers, dive brakes, and flaps. Spoilers extend from the upper surface of the wing, interrupting or spoiling the airflow over the wings. This action causes the glider to descend more rapidly. Dive brakes extend from both the upper and lower surfaces of the wing and help to increase drag.

Flaps are located on the trailing edge of the wing, inboard of the ailerons, and can be used to increase lift, drag, and descent rate. *[Figure 2-9]* Each flap type has a use depending on aircraft design. When the glider is cruising at moderate airspeeds in wings-level flight, the flaps can sometimes be set to a negative value (up from trail or level) for high speed cruising in some high efficiency gliders. When the flap is extended downward, wing camber is increased, and the lift and the drag of the wing increase.

Gliders are generally equipped with simple flaps and these flaps can generally be set in three different positions which are trail, down or negative. *[Figure 2-10]* When deflected downward, it increases the effective camber and changes the wing's chord line, which is an imaginary straight line drawn from the leading edge of an airfoil to the trailing edge. Both of these factors increase the lifting capacity of the wing.

Negative flap is used at high speeds at which wing lift reduction is desired to reduce drag. When the flaps are

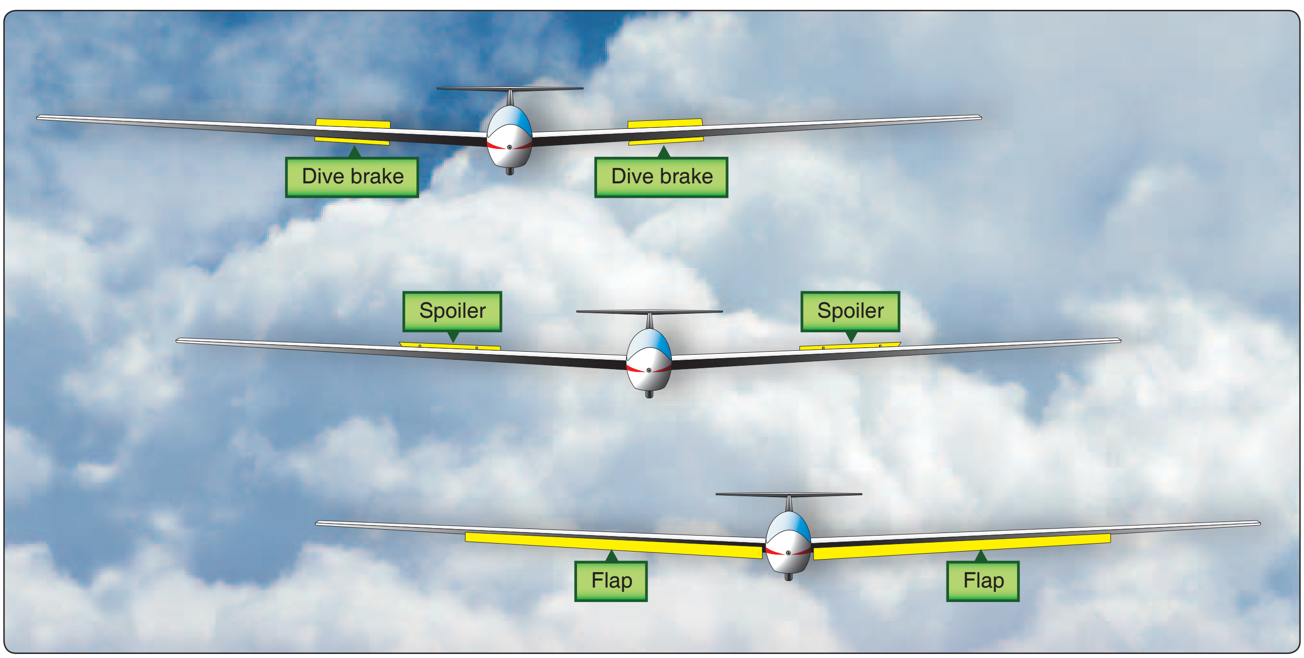

Figure 2-9. *Types of lift/drag devices.*

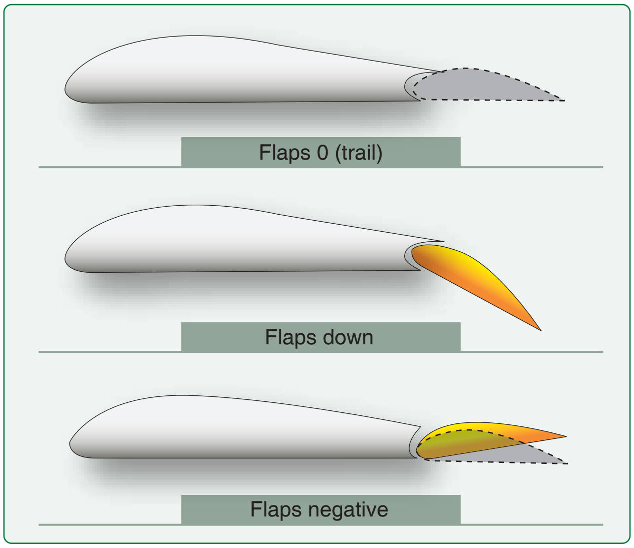

Figure 2-10. *Flap positions.*

extended in an upward direction, or negative setting, the effective camber of the wing is reduced, resulting in a reduction of lift produced by the wing at a fixed angle of attack and airspeed. This action reduces the down force, or balancing force, required from the horizontal stabilizer.

Empennage

The empennage includes the entire tail section, consisting of the fixed surfaces, such as the horizontal stabilizer and vertical fin, and moveable surfaces such as the elevator or stabilator, rudder and any trim tabs. These two fixed surfaces act like the feathers on an arrow to steady the glider and help maintain a straight path through the air. *[Figure 2-11]*

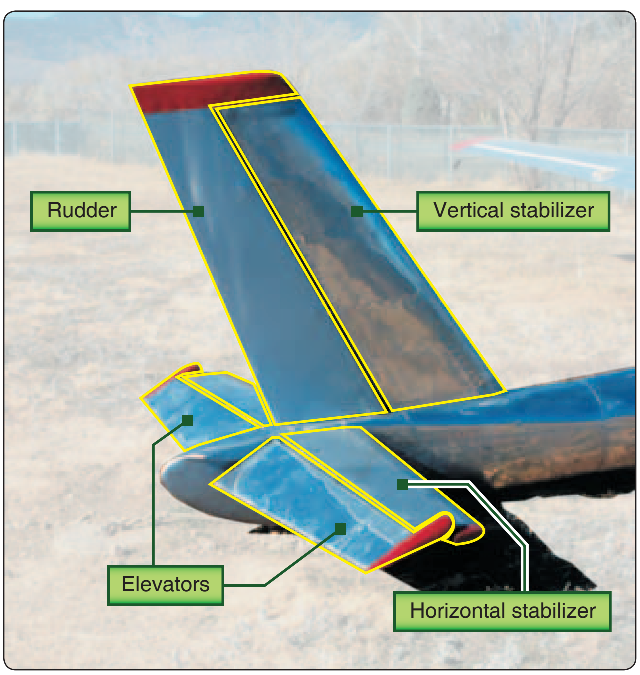

Figure 2-11. *Empennage components.*

The elevator is attached to the back of the horizontal stabilizer. The elevator controls movement around the lateral axis. This is known as pitch. During flight, the elevator is used to move the nose up and down, which controls the pitch attitude of the glider. The horizon is the primary pitch reference for a glider pilot. The elevator is primarily used to change or hold the same angle of attack of the glider. The trim tab, normally located on the elevator of the glider, lessens the resistance felt on the flight controls due to the airflow over the associated control surface.

The rudder is attached to the back of the vertical stabilizer. The rudder controls movement about the vertical axis. This is known as yaw. The rudder is used in combination with the ailerons and elevator to coordinate turns during flight.

Some gliders use a stabilator, which is used in lieu of an elevator and horizontal stabilizer. The stabilator pivots up and down on a central hinge point. When pulling back on the control stick, the nose of the glider moves up; when pushing forward, the nose moves down. Stabilators sometimes employ an anti-servo trim tab to achieve pitch trim. The anti-servo tab provides a control feel comparable to that of an elevator.

Trim devices reduce pilot workload by relieving the pressure required on the controls to maintain a desired airspeed. One type of trim device found on gliders is the elevator trim tab, a small, hinged, cockpit-adjustable tab on the trailing edge of the elevator. *[Figure 2-12]* Other types of elevator trim device include bungee spring systems and ratchet trim systems. In these systems, fore and aft control stick pressure is applied by an adjustable spring or bungee cord.

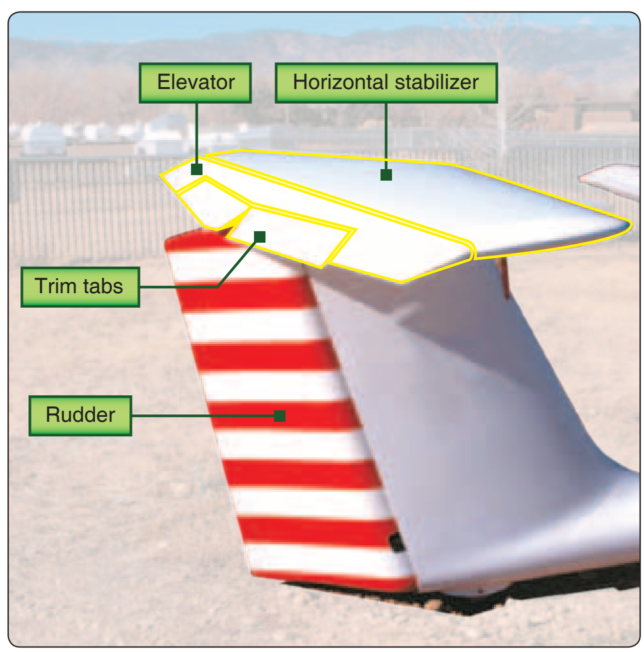

Figure 2-12. *Additional empennage components.*

Primary flight controls (aileron, elevator, and rudder), assisted by the trim devices, reduce control loading and provide positive feed to the pilot. The trim tab is either servo or anti-servo. *[Figure 2-13]* Anti-servo tab movement is opposite to the control surface providing a positive feedback (or feel) to the pilot. Servo tabs move in the same direction as the control surface and allow the pilot to remove (or lighten) control load, reducing fatigue during flight and providing aerodynamic trim.

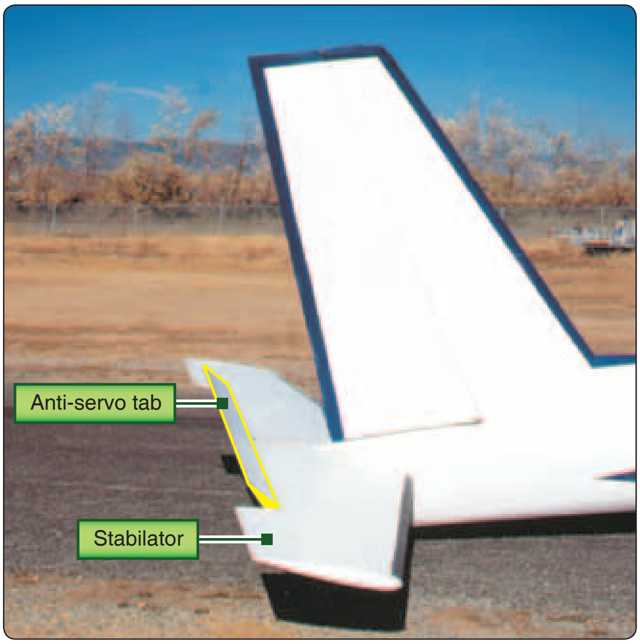

Figure 2-13. *Additional empennage components.*

Over the years, the shape of the empennage has taken different forms. Early gliders were most often built with the horizontal stabilizer mounted at the bottom of the vertical stabilizer. This type of tail arrangement is called the conventional tail. Other gliders were designed with a T-tail, and still others were designed with V-tail. T-tail gliders have the horizontal stabilizer mounted on the top of the vertical stabilizer, forming a T. V-tails have two tail surfaces mounted to form a V. V-tails combine elevator and rudder movements. This combination of elevator and rudder are referred as ruddervators.

Towhook Devices

An approved towhook is a vital part of glider equipment. The towhook is designed for quick release when the pilot exerts a pulling force on the release handle. As a safety feature (on most of the bellyhooks (CG hook)), if back pressure occurs from either getting out of position during the tow or overrunning the towrope, the release automatically opens. Part of the glider pilot's preflight is ensuring that the towhook releases properly with applied forward and back pressure.

The glider may have a towhook located on or under the nose and/or under the center of gravity (CG), near the main landing gear. The forward towhook is used for aerotow. The CG hook is used for ground launch. A glider with only a CG hook may be approved for aerotow in accordance with the Glider Flight Manual/Pilot's Operating Handbook. *[Figure 2-14]*

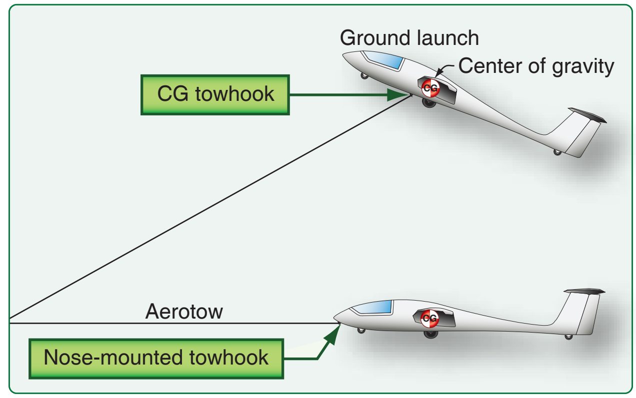

Figure 2-14. *Towhook locations.*

Powerplant

Self-Launching Gliders

Self-launching gliders are equipped with engines powerful enough to enable them to launch without external assistance. The engines may also be used to sustain flight if the soaring conditions deteriorate. Self-launching gliders differ widely in terms of engine location and type of propeller. There are two types of self-launching gliders: touring motor gliders and high-performance self-launching gliders.

Touring motor gliders are equipped with a fixed, nose-mounted engine and a full feathering propeller. *[Figure 2-15]* Touring motor gliders resemble an airplane to the untrained eye. They do have some basic airplane characteristics but are not certified as an airplane. On other types of self-launching gliders, the engine and propeller are located aft of the cockpit. High-performance self-launching gliders generally are seen with engines and propellers mounted behind the cockpit that completely retract into the fuselage for minimal drag in the soaring mode. *[Figure 2-16]* Propellers may fold or may simple align with the engine and retract completely. This configuration preserves the smooth low drag nose configurations important for good soaring efficiencies. When the engine and propeller are not in use, they are retracted into the fuselage, reducing drag and increasing soaring performance. These types of self-launch engines are usually coupled to a folding propeller, so the entire powerplant can be retracted and the bay doors are closed and sealed.

Figure 2-15. *A Grob G109B touring motor glider.*

Sustainer Engines

Some gliders are equipped with sustainer engines to assist in remaining aloft long enough to return to an airport. However, sustainer engines do not provide sufficient power to launch the glider from the ground without external assistance. These sailplanes are launched by either aerotow or ground launch. *[Figure 2-17]* A more detailed explanation of engine operations can be found in Chapter 7, Launch and Recovery Procedures and Flight Maneuvers.

Figure 2-17. *A Schleicher ASH 26e motor glider with the sustainer engine mast extended.*

Landing Gear

Glider landing gear usually includes a main wheel, a front skid or wheel and a tail wheel or skid, and often wing tip wheels or skid plates. Gliders designed for high speed and low drag often feature a fully retractable main landing gear and a small breakaway tailwheel or tail skid. Breakaway tail skids are found on high-performance gliders, and are designed to break off when placed under side loads. *[Figure 2-18]*

For safety reasons, the main landing gear remains extended during the launch process. If there is a tow break or early release, the pilot needs to focus on a safe return. The pilot's normal landing checklist provides a landing gear check, but during a low-altitude emergency, important items could be skipped on any checklist. Therefore, it is good practice to leave the main gear extended until reaching a safe altitude.

Wheel Brakes

The wheel brake, mounted on the main landing gear wheel, helps the glider slow down or stop after touchdown. The type of wheel brake used often depends on the design of the glider. Many early gliders relied on friction between the nose skid and the ground to come to a stop. Current glider models are fitted with drum brakes, disk brakes, and friction brakes. The most common type of wheel brake found in modern gliders is the disk brake, which is very similar to the disk brake on the front wheels of most cars. Most glider disk brakes are hydraulically operated to provide maximum braking capability. Wheel brake controls vary from one glider type to another.

Figure 2-16. *A DG-808B 18-meter high-performance glider in self-launch.*