



## Assembly and Storage Techniques

The assembly of a glider to include the installation of glider wings and tail surfaces is classified as operations functions not preventative maintenance. This information can be found in Amendment 43-27, published in 52 FR 17276, May 6, 1987 which is an amendment to 14 CFR part 43. Prior to assembling the glider, the pilot must check the required documentation that must be on board the glider for flight as required by Title 14 of the Code of Federal regulations (14 CFR) parts 21 and 91. Required documentation includes:

- Airworthiness certificate
- Registration
- Required placards
- GFM/POH

While preparing to assemble a glider, consider the following elements: location, number of crewmembers, tools and parts necessary, and checklists that detail the appropriate assembly procedures. Glider pilots should also develop and follow a procedure, or procedures, to deal with distractions that may occur during the glider assembly. Something as simple as rechecking the previous two steps and then continuing the checklist steps might be sufficient. The GFM/POH should contain checklists for assembling and preflighting a glider. If not, develop one and follow it every flight. Haphazard assembly and preflight procedures can lead to unsafe conditions.

Before assembling a glider, ensure that the glider trailer is secured with the wheel brake on and the wheels chocked. Adjust the leveling of the trailer as needed according to the GFM/POH so the glider can be removed without damaging items, such as the antenna and other glider components (e.g., wings, tips, horizontal elevator). If using a single rigging device, ensure that the wing holder is adjusted so the wing does not slide out of the holder and become damaged by striking or falling to the ground.

Find a location that shields the project from the elements and offers enough room for completion. Wind is an important factor to consider during an outdoor assembly. Each wing is an airfoil whether or not it is connected to the fuselage; even a gentle breeze is enough to produce lift on the wings, making them cumbersome or impossible to handle. If assembling the glider in a spot unshielded from the wind, great care must still be taken when handling the wings.

When performing the assembly inside a hangar, ensure there is enough room to maneuver the glider's components throughout the process. Also, consider the length of time anticipated to complete the entire procedure, and choose an area that allows complete undisturbed assembly. Moving the glider during assembly may cause parts or tools to be misplaced.

Wing stands or a wing dolly, the proper tools, wing tape, and lubricants should be on hand when assembling the glider. [Figure 6-1] To stay organized, use a written assembly checklist, and keep an inventory of parts and tools. Some organizations track tools and components by placing all of the necessary components and hardware used with necessary tools on a piece of canvas or material and outlining each tool. This facilitates a quick inventory before assembly and afterwards. Once glider assembly is complete, pilots should account for all parts and tools used during assembly. Objects inadvertently misplaced in the glider could become jammed in the flight controls, making control difficult, if not impossible. In addition, when taping the wing roots, turtle deck (cover where the flight controls are attached) elevator and other areas, ensure the tape is placed properly and is secure. If the seal tape comes off in flight, the tape may cause control issues with the glider.



Figure 6-1. Wing stands and wing dollies are used as support when assembling the glider.

Depending on the type of glider, two or more people may be required for assembly. It is important for everyone involved to maintain focus throughout the assembly process to avoid missed steps. Outside disturbances should also be avoided. Once the assembly is finished, a thorough inspection of all attach points ensures that bolts and pins were installed and secured properly. Do not use a hammer to tap wing bolts or other glider components in their place. The main wing pins should slide into the socket with minimum application of force. If the wing bolts require such force, a mechanic should be retained to ensure that the main wing spar is not bent or damaged.

On most gliders, the wing can be completely removed from the fuselage area. On some motor gliders, the wing can be folded up for ease of storage. [Figures 6-2] This allows the glider to be placed in a normal size hangar. Hangars are usually between 35 and 45 feet in width. Because most glider wings are a minimum of 40 feet (12 meters) total length, a larger hangar is usually desirable.

Once the gliders wings have been folded, the glider can easily be moved in and around the hangar area. On some gliders, operators may elect to leave the wings attached for quick access. This is usually the practice at larger glider operations. These gliders can be fitted or rolled onto a small dolly that has castering wheels. The glider's main wheel fits into a slot, and the entire glider can be pivoted and moved to accommodate other gliders.

Once the glider has been completely assembled, the pilot then inspects all critical areas to ensure all flight controls are attached. The pilot should refer to a written checklist either provided by the manufacturer or a commercial source that prints glider checklists.

This final check is very critical and usually takes time to complete. Pilots should not be interrupted when they are attempting to check the glider. The Soaring Society of America (SSA) and one of its affiliates, the Soaring Safety Foundation (SSF), have developed a checklist for preparing a glider, which

is Safety Advisory 00-1, Glider Critical Assembly Procedures, and can be found in Appendix A of this handbook.

Many manufacturers provide a critical assembly checklist (CAC) to be completed after assembly, which is the preferred method of ensuring a proper assembly has been completed. When provided by the manufacturer, it is mandatory. A positive control check (PCC) is not a CAC, but an additional means of verification. If a CAC is provided, it must be used as is any other checklist a manufacturer provides. A PCC is not regulatory, but it is a good idea whether or not you just completed the required CAC.

### Trailer

Specially designed trailers are used to transport, store, and retrieve gliders. [Figure 6-3] The components of the glider should fit snugly without being forced, be guarded against chafing, and be well secured within the trailer. Once the loading is completed, take a short drive, stop, and check for rubbing or chafing of components. Ensure that any items carried inside the trailer are secure from movement. For example, jacks, ramps, wing stands, and ground dollies must be secured so that these items do not damage the glider.



Figure 6-3. Components of a glider stored and transported in a trailer.



Figure 6-2. The wings of the glider can be folded in order to conveniently store the glider.

Prior to taking the trailer on the road, complete a thorough inspection. Ensure:

- Proper inflation of and adequate tread on trailer tires,
- Trailer tires are rated for Special Trailer (ST) duty, which are rated only to 65 miles per hour (mph) towing speed. The maximum speed of 65 mph can be exceeded safely if the air pressure is increased by 10 psi for every 10 mph over 65 that it is pulled and the maximum load is decreased 10 percent for every 10 mph over 65 mph of towing speed,
- Operation of all lights,
- Free movement and lubrication of hitch,
- Appropriate rating of vehicle attachment for the weight of the trailer,
- Proper operation of vehicle and trailer brakes,
- Adequate wheel bearing lubrication, and
- Proper tow vehicle mirror adjustment.

When using a trailer, there are other precautions to note. First, avoid towing with too much or too little tongue weight as either causes the trailer to fishtail at certain speeds, possibly rendering it uncontrollable. Towing a long glider trailer requires good driving skills and a good sense of road and weather conditions. Take care in heavy crosswinds because a long trailer can be affected by windy conditions. Also, take care when unloading the glider to avoid damage. Practice and planning are key to a successful operation.

### Tiedown and Securing

Anytime the glider is left unattended, it should be tied down with the canopy closed and latched. When selecting a tiedown location, choose a spot that faces into the wind if possible. Permanent tiedowns are often equipped with straps, ropes, or chains for the wings and tail. Having the proper tie down kit is recommended for a cross-country trip. Check tiedown conditions before using to ensure the safety of the glider. When tying down on airports shared by powered aircraft, propeller wash can cause damage to an improperly secured glider.

If strong winds are expected, tie the spoilers open with seat belts, or place a padded stand under the tail to reduce the angle of attack of the wings. This reduces the pull of the glider against the tiedowns. When securing the glider outside for an extended period of time, install gust locks on the control surfaces to prevent them from banging against their stops in the wind. Cover the pitot tube and the total energy probe to prevent spiders, wasps, and other insects or debris from getting inside. [Figure 6-4]



**Figure 6-4.** Protecting the pitot tube and total energy probe.

Always use a cover to protect the glider canopy. It can be damaged by blowing dust and sand or scratched by apparel, such as watches or belt buckles. A cover protects the canopy from damage while shielding the interior of the cockpit from ultraviolet (UV) rays. [Figure 6-5]



**Figure 6-5.** Protecting the canopy.

### Water Ballast

When transporting a glider or parking the glider for long periods of time, especially overnight the water ballast should be emptied due to the danger of freezing. This is usually done while in flight before landing. When de-rigging, the water ballast tanks will empty themselves through the wing root connecting pipes. If the glider has to be towed for a long way it is best to empty the water tanks. If that is not an option, ensure that antifreeze is added to prevent freezing when traveling in cold temperatures.

### Ground Handling

Moving a glider on the ground requires special handling procedures, especially during high winds. Normally, gliders are pushed or pulled by hand or towed with a vehicle. When moving a glider, ensure that all appropriate personnel have been briefed on procedures and signals.

When using a vehicle to tow a glider, use a towline that is more than half the wingspan of the glider. If one wingtip stops moving for any reason, this towline length prevents the glider from pivoting and striking the tow vehicle with the opposite wingtip. Full wingspan length is desirable; however, half the wingspan plus 10 feet provides safe operation. Ensure that the glider canopy is always closed if no one is around the glider. This prevents the wind, or turbulence from a taxiing towplane, to cause the canopy to close abruptly, which could damage the canopy frame or even crack the canopy glass.

When starting, slowly take up slack in the line with the vehicle to prevent sudden jerking of the glider. The towing speed should be no faster than a brisk walk. When towing a glider, always use at least one wing walker. The wing walker and the driver of the tow vehicle function as a team, alert for obstacles, wind, and any other factor that may affect the safety of the glider. The driver should always stay alert for any signals from the wing walkers. [Figure 6-6]



**Figure 6-6.** Positioning the glider for the tow vehicle.

If it is necessary to move the glider during high winds, use two or more crewmembers placed at the wingtips and tail. Also, have a pilot in the cockpit, with the spoilers deployed, holding the controls appropriately to reduce lift on the glider. Strong winds and gusts can cause damage to the glider during ground handling, so exercise care during these conditions.

Another method of towing uses specially designed towing gear similar to a trailer tow bar that attaches directly to a vehicle towing a trailer. The tow bar makes guiding the glider much easier and allows the wing walkers to concentrate on ensuring wingtip clearances. [Figure 6-7]

### Launch Equipment Inspection

Prior to making a flight, it is important to inspect the condition of the towline/towrope. The glider pilot is primarily responsible for inspection and selection of the proper towrope. However, the tow pilot has a responsibility to ensure that the towrope selection meets the criteria stated in 14 CFR part 91 and is acceptable for use. This inspection is the responsibility of the tow pilot. The towline should be free from excess wear; all strands should be intact, and the line should be free from knots. Towropes should be inspected prior to every flight. Consideration should be given in replacing the towrope after a period of time due to usage and ultraviolet (UV) exposure from being in the sun and exposed to the elements. [Figure 6-8] 14 CFR part 91, section 91.309, requires that the strength of the towline be within a range of 80 to 200 percent of the maximum certificated weight of the glider. If the towrope is more than twice the maximum strength, a safety link is required between the tow rope and glider rated at not less than 80 percent of the maximum certified operating weight of the glider but not greater than twice the operating weight. Also, a safety link must be installed between the towing aircraft and towrope with breaking strength greater than the glider safety link, but no more than 25 percent greater, and not greater than twice the maximum certificated weight of the glider. Figure 6-9 shows the strength of some ropes typically used.



**Figure 6-7.** A wing dolly (left) ready for attachment and a tail dolly (right) being used for glider transport.

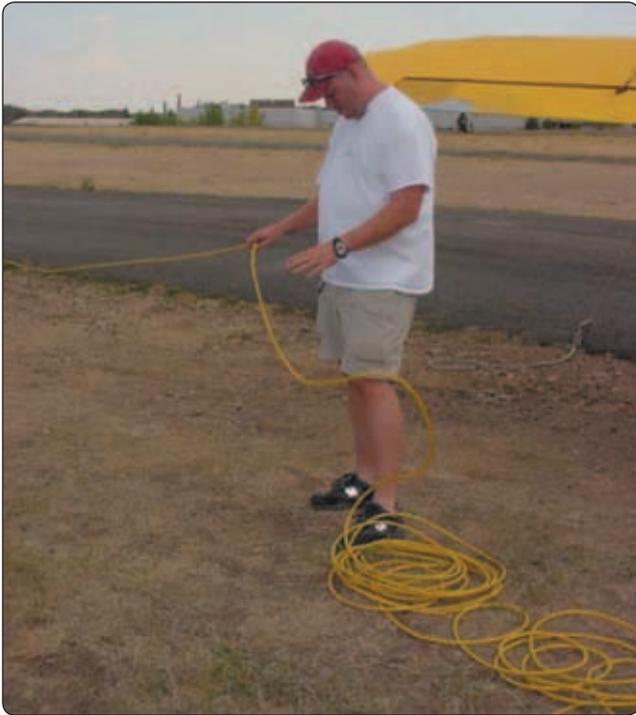


Figure 6-8. Inspecting the towline.

Diameter	Nylon	Dacron	Polyethylene		Polypropylene
			Hollow braid	Monofilament	Multifilament
3/16"	960	720	700	800	870
1/4"	1,500	1,150	1,200	1,300	1,200
5/16"	2,400	1,750	1,750	1,900	2,050

Figure 6-9. Rope strengths.

A knot in the towline reduces its strength by up to 50 percent, and causes a high spot in the rope that is more susceptible to wear. Pay particular attention to the ring area to which the glider attaches because this is also a high-wear area.

The safety link is constructed of towline with a towring on one end and the other end spliced into a loop. The weak link at the glider attach end of the towline must be 80 to 200 percent of the maximum certificated operating weight of the glider. The safety link at the towplane attach end must be of greater strength than the safety link at the glider attach end of the towline, but not more than 25 percent greater, nor greater than 200 percent of the maximum certificated weight of the glider. Towlines and weak links are assembled using a towring that is appropriate for the operation. Lightweight balls are attached to the towline to help protect the towline, prevent line rash, and prevents the line from whipping. [Figure 6-10]

The tow hooks on both the glider and the towplane need to be inspected. The two most common types of tow hook are an over-the-top design, such as a Schweizer hook, or a grasping style, such as a Tost hook. Any tow hook must be freely operating, and free from damage. [Figures 6-11 and 6-12]

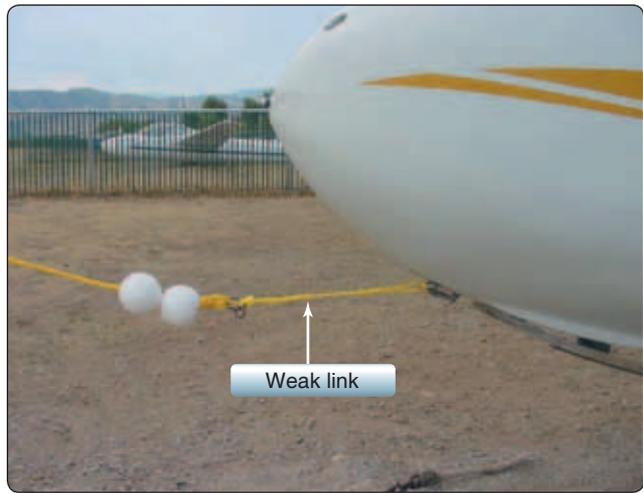


Figure 6-10. The weak link.



Figure 6-11. Schweizer-type tow hook.



Figure 6-12. Tost hook.

### Glider Preflight Inspection

A thorough inspection of the glider should be accomplished before launch. A preflight checklist for a glider should be in the GFM/POH. If not, develop a checklist using the guidelines contained in Figure 6-13.

- Begin by assessing the overall condition of the fiberglass or fabric.
- Be alert for signs of damage or excessive wear.
- Ensure that the canopy is clean and free from damage.
- Verify the interior wing and control connections are safe and secure.
- If a battery is used, ensure that it is charged and safely fastened in the proper spot.
- Ensure that seat harnesses are free from excessive wear.
- Buckle and tighten any harness that will not be used to prevent it from inadvertently interfering with controls.
- Test the tow hook to ensure it is operating correctly.
- Inspect top, bottom, and leading edge of wings, ensuring they are free from excess dirt, bugs, and damage.
- Inspect spoilers/dive brakes for mechanical damage. They should be clear of obstructions.
- Inspect the wingtip and wingtip skid or wheel for general condition.
- Inspect ailerons for freedom of movement, the condition of hinges and connections, and the condition of the gap seal.
- Check the condition of flaps for freedom from damage and for appropriate range of motion.
- Inspect the general condition of the empennage.
- Check static ports, pitot tube, and total energy probe to ensure they are free from obstruction.
- Check top, bottom, and leading edge of tailplane for of bugs, dirt, and damage.
- Check the landing gear for signs of damage or excessive wear. The brake pads should be checked if they are visible; otherwise, the brakes can be checked by pulling the glider forward and applying the brakes. Note that the landing gear is frequently a problem area for gliders used in training.
- Check elevator and trim tab for condition of connections, freedom of movement, and condition of gap seal.
- Check rudder freedom of movement and condition of connections.

**Figure 6-13.** A glider preflight inspection checklist.

### Prelaunch Checklist

Adjustments to the pilot or passenger seats, as well as adjustable controls, such as rudder pedals, should be made prior to buckling the seat belt and shoulder harness. Caution should be exercised to avoid crimping or clamping the oxygen supply. At this point, especially if the glider has just been assembled, it is appropriate to do a positive control check with the help of one crewmember. While the pilot moves the control stick, the crewmember alternately holds each aileron and the elevator to provide resistance. This also applies to the spoilers and flaps, and ensures the control connections are correct and secure. If the stick moves freely while the control surfaces are being restricted, the connections are not secure, and the glider is not airworthy. [Figure 6-14]

If the GFM/POH does not provide a specific prelaunch checklist, then some good generic checklists are CB SWIFT CBE and ABCCDD, which are explained in Figure 6-15. Regardless of which checklist you elect to use, have a plan. Stay with that checklist and ensure that each step is being carefully followed.

### Glider Care

Depending on the type of glider, different cleaning methods should be employed. After all flights, wipe down the glider with a soft cloth or a wet chamois. This removes any debris



**Figure 6-14.** Positive control check of spoilers.

or bugs. This should be done in a timely manner because waiting too long allows bugs to dry making removal difficult.

Training gliders made of fabric should be cleaned with spray-on and wash-off products. Avoid using large amounts of water as the water may penetrate cracks and holes, especially on earlier wooded or vintage gliders, which damages and reduces the life of the fabric or wood. Moisture damages any glider if allowed to stay wet. On metal gliders, a low-pressure hose and mild detergent is used for cleaning. For

Before Takeoff Checklist	
<b>Phase I:</b>	<ul style="list-style-type: none"> <li>• Controls (plural)</li> <li>• Ballast</li> </ul>
<b>Phase II:</b>	<ul style="list-style-type: none"> <li>• Straps (plural)</li> <li>• Wind</li> <li>• Instruments (plural)</li> <li>• Flaps (singular)</li> <li>• Trim</li> </ul>
<b>Phase III:</b>	<ul style="list-style-type: none"> <li>• Canopy</li> <li>• Brakes (singular for most gliders, plural for a Blanik, since the wheel brake is not at the end of the air brake travel)</li> <li>• Emergency plan (the three phases plus the return speed that can and should be briefed prior to closing the canopy)</li> </ul>
<b>A</b>	Altimeter set to correct elevation
<b>B</b>	Seat belts and shoulder harnesses fastened and tightened
<b>C</b>	Controls checked for full and free movement
<b>C</b>	Cable or towline properly connected to the correct hook
<b>C</b>	Canopy closed, locked, and checked
<b>D</b>	Dive brakes closed and locked
<b>D</b>	Direction of wind checked and emergency plan reviewed

Figure 6-15. Generic prelaunch checklists.

high performance fiberglass gliders, use a special spray or cleaning paste. Consult the GFH/POH, or a glider supply store, for proper materials based on the type of glider. Care must be taken when cleaning high performance and fiberglass gliders. The use of buffers should be avoided, as the buffer may burn the fiberglass if not done in a proper manner.

After cleaning, a coat of wax or a sealer is usually applied to fabric, metal, and fiberglass gliders. When applying wax to fiberglass gliders, it is recommended to use a silicon-free wax. Silicon adheres to the pores in the fiberglass and makes any type of future repairs extremely difficult. After applying any wax, use a clean, soft cloth to wipe off excess wax and buff the area by hand. For the cleaning of the canopy, care must be taken and only recommended cleaners for the specific type of canopy should be used.

Minor repairs on fiberglass gliders can be performed by the owner/pilot. Consult a fiberglass expert prior to making any minor repair, such as a scratch or chip. Always use approved parts and materials when conducting these repairs. All certifications of gliders, either standard or experimental, should be repaired in accordance with the manufacturer's recommended procedures and 14 CFR part 43. Pilots should always refer to the specific GFM/POH for any additional care and cleaning of the glider.

## Preventive Maintenance

Preventive maintenance is limited to the following work, provided it does not involve complex assembly operations. For more information on preventive maintenance, refer to Appendix A to Part 43, Major Alterations, Major Repairs, and Preventive Maintenance.

- Removing, installing, and repairing of landing gear tires
- Replacing elastic shock absorber cords on landing gear
- Servicing landing gear shock struts by adding oil, air, or both
- Servicing landing gear wheel bearings, such as cleaning and greasing
- Replacing defective safety wiring or cotter keys
- Lubricating cover plates, cowlings, fairings, etc., that do not require disassembly other than removal of nonstructural items
- Making simple fabric patches not requiring rib stitching or the removal of structural parts or control surfaces
- Replenishing hydraulic fluid in the hydraulic reservoir
- Refinishing decorative coating of fuselage, wings, tail group surfaces (excluding balanced control surfaces), fairings, cowlings, landing gear, cockpit interior when removal or disassembly of any primary structure or operating system is not required
- Applying preservative or protective material to components for which no disassembly of any primary structure or operating system is involved and on which such coating is not prohibited or is not contrary to good practices
- Repairing upholstery and decorative furnishings of the cockpit when the repairing does not require disassembly of any primary structure or operating system or interfere with an operating system or affect the primary structure of the aircraft
- Making small, simple repairs to fairings, nonstructural cover plates, cowlings, and small patches and reinforcements that do not change the contour enough to interfere with proper air flow
- Replacing side windows where that work does not interfere with the structure or any operating system, such as controls, electrical equipment, etc.
- Replacing safety belts
- Replacing seats or seat parts with replacement parts approved for the aircraft not involving disassembly of any primary structure or operating system

- Troubleshooting and repairing broken circuits in landing light wiring circuits
- Replacing bulbs, reflectors, and lenses of position and landing lights
- Replacing wheels for which no weight and balance computation is involved
- Replacing any cowling not requiring removal of the propeller or disconnection of flight controls
- Replacing or cleaning spark plugs and setting spark plug gap clearance
- Replacing any hose connection, except hydraulic connections
- Replacing prefabricated fuel lines
- Cleaning or replacing fuel and oil strainers or filter elements
- Replacing and servicing batteries
- Replacing or adjusting nonstructural standard fasteners incidental to operations
- Removing, checking, and replacing magnetic chip detectors

