RESTRICTED

Pilot Training Manual for the

CG-4A

GLIDER

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CG-4A

GLIDER

PREPARED FOR HEADQUARTERS AAF

OFFICE OF ASSISTANT CHIEF OF AIR STAFF TRAINING

BY HEADQUARTERS AAF, OFFICE OF FLYING SAFETY

RESTRICTED


U.S.

Foreword

This manual is the text for your training as a glider pilot.

The Air Forces' most experienced training and supervisory personnel have collaborated to make it a complete exposition of what your pilot duties are, how each duty is to be performed, and why it must be performed in the manner prescribed.

The techniques and procedures described in this book are standard and mandatory. In this respect the manual serves the dual purpose of a training checklist and a working handbook. Use it to make sure that you learn everything described herein. Use it to study and review the essential facts concerning everything taught. Such additional self-study and review will not only advance your training, but will alleviate the burden of your already overburdened instructors.

This training manual does not replace the Technical Orders for the glider, which will always be your primary source of information concerning the CG-4A so long as you fly it. This is essentially the textbook of the CG-4A. Used properly, it will enable you to utilize the pertinent Technical Orders to even greater advantage.

H. H. Arnold

COMMANDING GENERAL, ARMY AIR FORCES

Additional copies of this Manual

may be obtained, upon request, from

Hq. AAF, Office of Flying Safety, Safety Education Division,

Winston-Salem 1, N. C.

YOUR JOB

You have an important job—that of carrying airborne troops and equipment behind enemy lines, over unfamiliar territory, and into strange landing areas. It's a big responsibility, and demands your best.

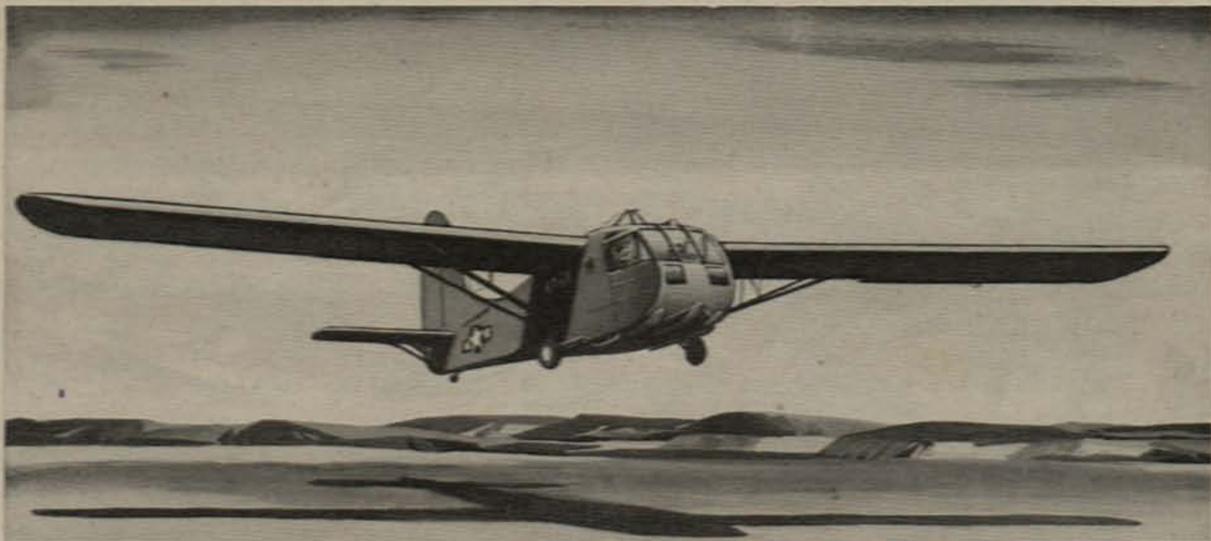
Glider flying calls for no techniques unfamiliar to the power pilot, but it does require a new emphasis on certain old techniques. To be a competent glider pilot, for instance, you must be a specialist in landings. The success of any glider mission depends on your ability to land your passengers and cargo safely at a given point and time. There are no reserves in an airborne invasion. If you fail to deliver your load at the right spot, you may turn victory into failure and cause a needless sacrifice of life.

Contrary to popular belief, the glider is not limited to a single mission. Neither are you. The ground combat training you receive is to enable you to defend yourself until you can be evacuated for another mission.

Your primary responsibility is flying. Your secondary duty, since it is not always feasible to evacuate you immediately upon landing, is to fight as a ground soldier with the airborne troops you have transported. Only your primary duty—that of flying—is considered in this manual.

Glider flying under conditions encountered in combat demands all the knowledge and skill you can acquire. There are no nearby towns to illuminate the sky at night and no welcome airfields on which to land; high trees may block your approach, and rock-strewn, stump-studded fields may endanger your landing. The additional hazard of ground fire further complicates the task.

Your training conditions you to overcome natural instincts under such circumstances, and follow correct procedures designed to get you down safely. In training you fly under a merciless sun in a monotonous pattern. You fly at night under adverse conditions. If it seems unnecessary at the time, remember that such training prepares you for combat. Take advantage of it.



YOUR GLIDER

The glider you fly has a brief but eventful history with the AAF to date, and undoubtedly will add many pages to the saga of World War II.

Already it has served in every theater of operation in which the Allies are fighting.

Though old in experience, the glider, comparatively speaking, is the infant in the AAF family. The entire program is so new that it has been forced to cope with inexperience, improper design, pilot training problems, and poor coordination with other task forces.

Despite this and its clumsy, blunt-nosed appearance, the CG-4A glider has proved its value and now shares the spotlight with power planes. The first large scale use of gliders in the European theater of operations was on June 6, 1944, when France was invaded. The success of this assignment was viewed by Allied Supreme Headquarters as sufficient to warrant "sober satisfaction." This conservative expression confirmed a more out-spoken belief already shared by the Troop Carrier and Training Commands, which train glider pilots.

The approval bestowed by Allied Headquarters came after a 50-mile glider train landed airborne troops behind enemy lines to blow up gun positions, block roads, and hold off the enemy until beach landings could be made. Although hundreds of gliders were used, losses were slight.

The combat employment of the glider in the initial invasion of France occurred less than 3 years after General Arnold told a glider graduating class of six that the United States would have a glider force "second to none in the world." Before September, 1942, AAF records listed no glider pilots.

The AAF went to work to build a glider force. CAA files were checked, but only 160 licensed civilian glider pilots were found in the United States. Of these, only 25 were sufficiently experienced to be instructors. They were put to work immediately to train Air Corps rated pilots for key positions. Enlisted men and thousands of recruited civilians were selected as pilot trainees. As they were trained, the best were retained to instruct others, and so the training organization developed.

Soon after training commenced, all gliders were grounded for technical reasons. Abandonment of the program seemed probable. The glider survived this critical period, however, and on the night of July 9, 1943, took part in the first Allied airborne operation in World War II.

Allied gliders took off that night from an airfield in Tunisia. Their destination was Axis-held Sicily; their cargo, British airborne troops. Many of the difficulties to be expected on a first mission of this nature were encountered, but enough of the gliders got through to accomplish their mission. Their work that night helped disorganize the enemy and assisted in establishing the beachhead.

A demonstration was held for General Arnold in August, 1943. After watching the gliders slip stealthily into a small North Carolina field at night, and land almost within his reach, General Arnold exclaimed, "Marvelous!"

In February, 1944, gliders carved another niche for themselves, in Burma.

The Allies devised a plan to concentrate a force behind Japanese lines to cut enemy rail and river communications. There were no handy roads and the landing areas were unprepared. Gliders were picked to fly certain troops, airborne engineers, and equipment into the selected areas by night. Their job was to seize and prepare landing strips so that additional troops and equipment might be flown in by transport planes.

Only a limited number of gliders were used, but the operations were successful, the landing strips prepared, and troops and cargo were poured into the rear of the enemy positions.

Most of the missions were accomplished at night. The Japanese were completely surprised, and the missions were performed without enemy opposition.

Figures on the number of troops, animals, and tons of cargo transported prove conclusively that the glider is an important addition to the Air Forces.

To understand the combat capabilities of the glider, a knowledge of its possible uses is essential. Gliders may be used for:

1. Airborne invasion.
2. Landing troops in rear of enemy lines to assist a break-through, disrupt communications, and block movement of enemy reserves.
3. Landing troops to seize and hold key terrain or enemy installations, or to prevent an enemy withdrawal.
4. Supporting a break-through, by landing troops behind weak sections in friendly lines.
5. Capturing and holding airfields within enemy territory.
6. Preceding spearheads.
7. Establishing a bridgehead or a beachhead.
8. Assisting ground forces in reduction of enemy strong points.
9. Sabotage missions.
10. Supply and re-supply to airborne units participating in an airborne invasion.
11. Supply to other ground units cut off from normal communication channels.
12. Landing supplies and equipment in locations where powered aircraft cannot land.
13. Evacuating casualties and other crew members, by making use of pick-up system.
14. Supplementing the transportation services of other agencies.

YOUR INSTRUCTOR

Your instructor was chosen because he is a good glider pilot and a good teacher. His job is to teach you to become a glider pilot capable of carrying out any mission assigned to you in combat. If you fail, it is a reflection on his instruction. He is anxious for you to succeed.

The only two ways he can teach you are by telling you, then showing you. Give him your undivided attention. If you don't understand, say so. He's always glad to explain, and will appreciate your interest. However, don't ask questions just for the sake of impressing him.

Keep a notebook to which you can refer. If you can explain a lesson correctly in writing, you understand it.

Cooperate with your instructor, pay attention, and your chances of succeeding are good.

Work With Your Towpilot

The chance of meeting your towpilot during training is remote.

Although you may never meet him, you soon learn that his is not an easy job. The success of your landing depends, to a great extent, on his ability to tow you to the correct release point.

Techniques for glider flying while in tow are designed to make this job easier for the towpilot, by reducing strain both on the towplane and on him. You can assist by following the procedures set forth here.

He has often been described as the forgotten man, in training, but in combat, teamwork between glider pilot and towpilot is vital. No mission can succeed without it.

COMMON ERRORS

Following are some general shortcomings frequently found in students. Your instructor bases some of your grades on these points. Forewarned is forearmed!

Common Errors in Attitude

1. Lack of military discipline.
2. Being disinterested, listless.
3. Disliking flying.
4. Non-aggressiveness, lack of initiative.
5. Not asking pertinent questions.
6. Asking unnecessary questions.
7. Being surly, resentful.
8. Fearing glider, or a specific maneuver.
9. Wasting solo time.
10. Wasting spare ground time.
11. Cockiness.
12. Lacking self-reliance.
13. Polishing the apple.

Common Errors in Technique

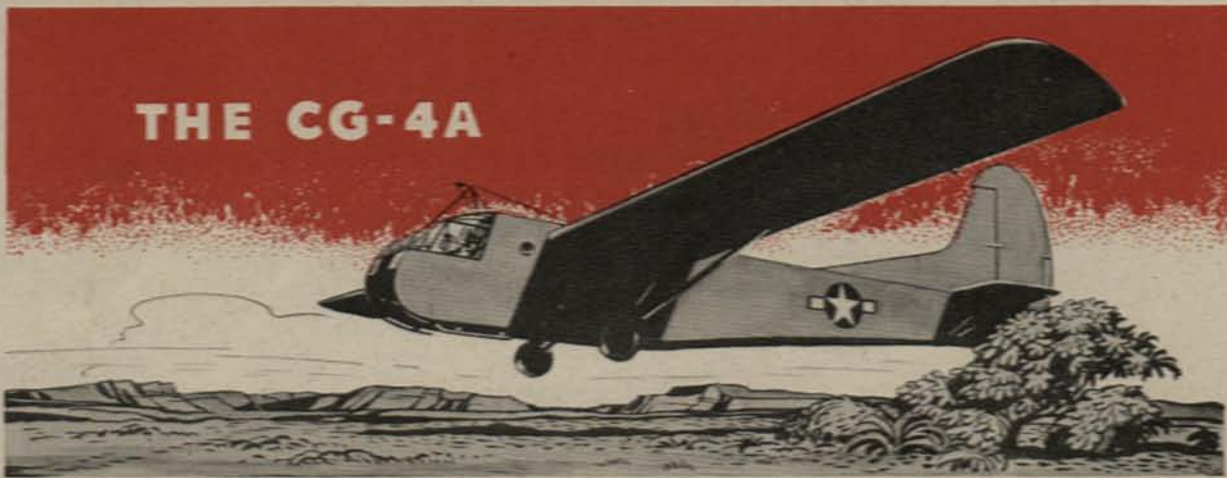
1. Not coordinating; no feel of glider.
2. Varying speed in turn.
3. Rough control movements (tense, jerky).
4. Making corrections too slowly.
5. Carelessness about details.

Common Errors in Judgment

1. Not thinking ahead of glider.
2. Making dangerously low turns.
3. Slow in making decisions.
4. Recklessness.
5. Poor judgment of speed and distance.

Common Errors in Progress

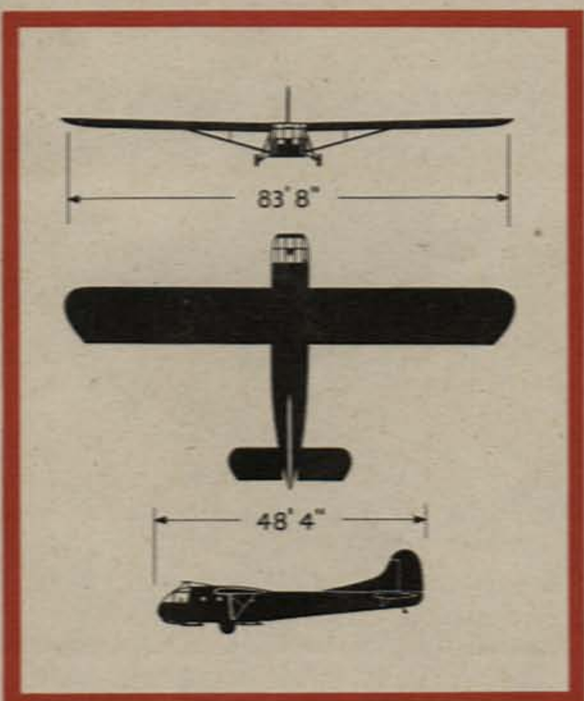
1. Slow understanding.
2. Poor retention of instruction.
3. Lack of progress after adequate instruction.



The CG-4A glider is a 15-place, high-wing cabin monoplane having a fabric-covered, steel-tube fuselage, wood wing with plywood and fabric covering, fixed-type landing gear and nose skids, and hydraulic brakes.

Flight Controls

Dual wheel controls, side by side; adjustable rudder pedals; toe brakes on the pilot's side only; trim tab controls, and dual lever-operated spoiler controls.



Instrument Error

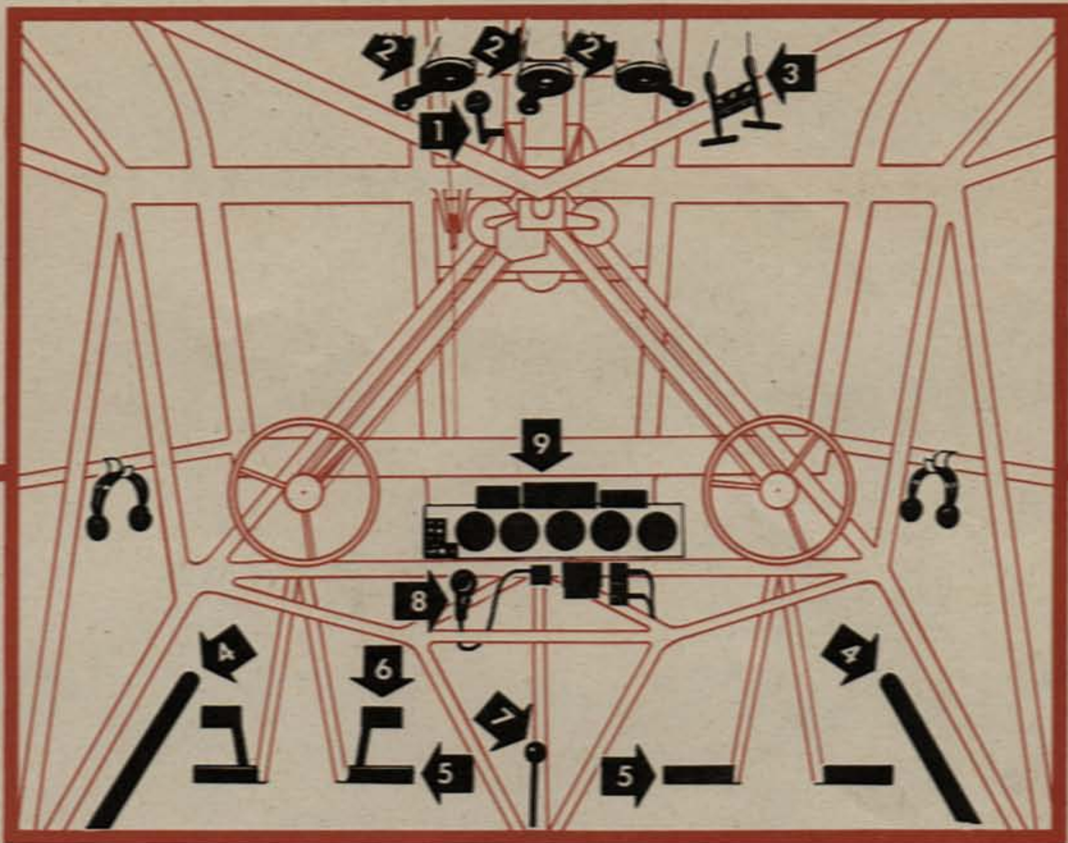
The location of the pitot-static tube causes an error in readings for both the airspeed indicator and the altimeter. The reason for this error is that the pitot-static head is in a low-pressure, high-velocity area in the airstream which sweeps over the nose section. The high velocity of air in this area accounts for an exaggerated reading of 128 mph in indicated airspeed (IAS) when calibrated airspeed (CAS) is 120 mph.

As your airspeed drops, the error of reading on your airspeed indicator increases slightly. The error throughout the range of glide speeds (60 to 85 mph IAS) averages 10 mph.

Indicated airspeeds referred to in this manual, therefore, are only approximations, and are so marked. They are given in round numbers, and are followed in parentheses by calibrated airspeeds.

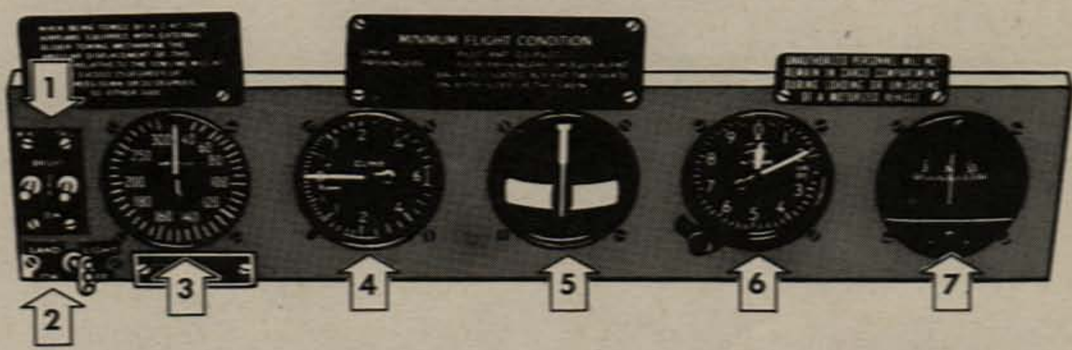
Because of this instrument error, learn to rely on the feel and sound of your glider, especially when flying close to the stall speed.

The location of the pitot-static tube also causes an error in the reading of the altimeter. The lower air pressure in the area of the static opening causes the altimeter—when CAS is 120 mph—to indicate an altitude 200 feet higher than you are actually flying.



COCKPIT

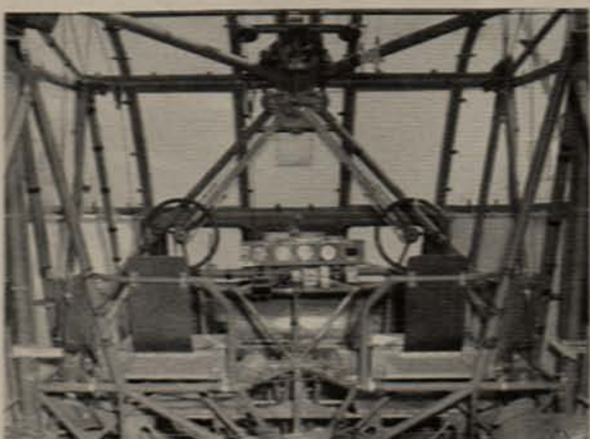
1. Towline release.
2. Trim tabs.
3. Parachute release.
4. Spoiler control.
5. Rudder pedal.
6. Toe brake.
7. Nose release.
8. Interphone system.
9. Instrument panel.



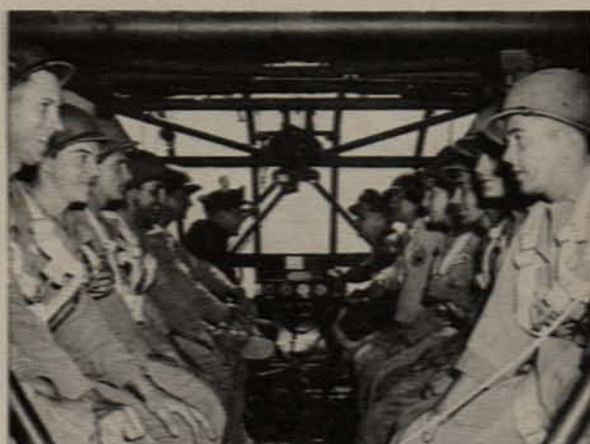
INSTRUMENT PANEL

1. Navigation light switches.
2. Landing light switch.
3. Airspeed indicator.
4. Rate-of-climb indicator.
5. Bank and Turn indicator.
6. Altimeter.
7. Compass.

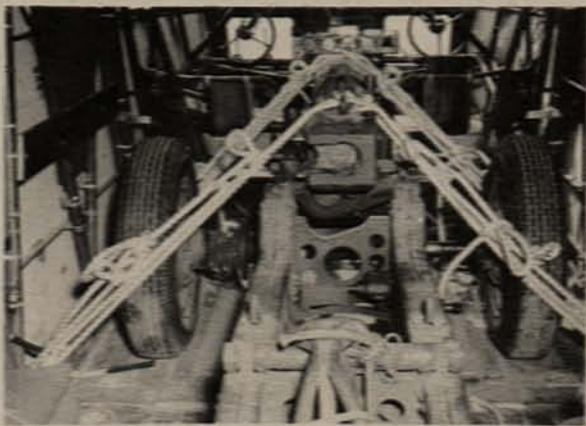
EQUIPMENT



Non-adjustable cockpit seats.



Troops use removable wooden benches.



Cargo tied to fittings along sides.

Emergency doors on both sides.

Cockpit seats, non-adjustable, are mounted directly on the fuselage. There are safety belts for crew and passengers.

Removable wooden benches are fastened longitudinally in the fuselage when troops are being carried.

Tie-down fittings at the lower ends of all vertical tubing members along the sides of the cargo compartment are used to anchor cargo.

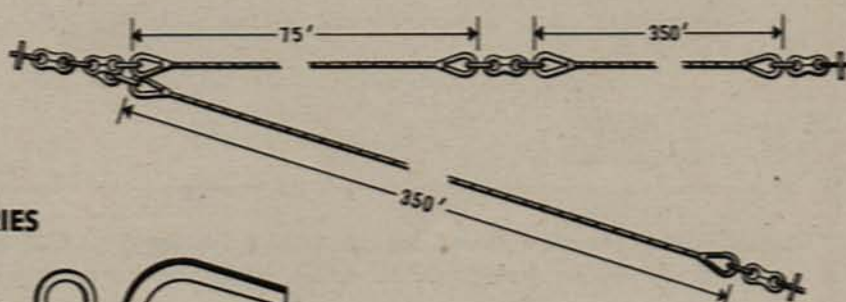
The nose is lifted manually, except when a jeep is being unloaded. In this case, the jeep (¼-ton truck) is attached to a lifting mechanism which raises the nose section.

Emergency doors are located halfway between cockpit and entrance doors.

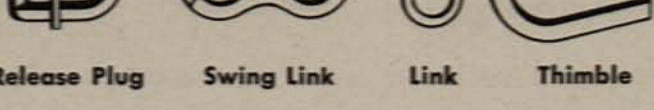
A 12-volt battery furnishes power for navigation and cockpit lights.

A 350-foot 11/16-inch nylon rope, attached to the nose of the glider, is used on single tow, with a 425-foot rope for the glider on the right when on double tow. Nylon is used for two reasons: not only because it is strong, but because its elastic quality permits it to stretch readily under shock, yet contract slowly when tension is reduced, absorbing all stresses.

The CG-4A has a type A1A-1 interphone system for communication between glider and towplane. The unit consists of a microphone for the pilot, and three headsets, one each for pilot, copilot, and crew chief. A 3-conductor insulated wire, either woven in or attached to the towline, forms the connection between the glider and the interphone system of the towplane. Operation of the equipment is simple. To talk from the glider, simply press the large thumb button on the hand-held microphone.



TOWLINE AND ACCESSORIES



Release Plug **Swing Link** **Link** **Thimble**

FLIGHT CHARACTERISTICS

The CG-4A was not designed as a sailplane. It is simply a cargo-carrying airplane without engines, and falls in the same category as other troop-carrier type aircraft. The CG-4A reacts to the same aerodynamic forces with the same controls and in the same manner as the airplane. Any heavier-than-air pilot can step from the cockpit of one to the other and feel at home at the flight controls after normal transition training.

SPEED AND LOAD LIMITATIONS

Maximum designed speed on tow or in free flight	150 mph CAS
Maximum designed gross weight (normal load)	7500 lbs.
Maximum emergency gross weight (not to be exceeded)	9000 lbs.
Minimum load: Pilot, copilot, and 600 lbs. of ballast (300 lbs. behind each cockpit seat)	

Gross Weight	Maximum Permissible CAS	Maximum Permissible IAS
7500	150 mph	158 mph
8000	143	151
8500	135	143
9000	128	136

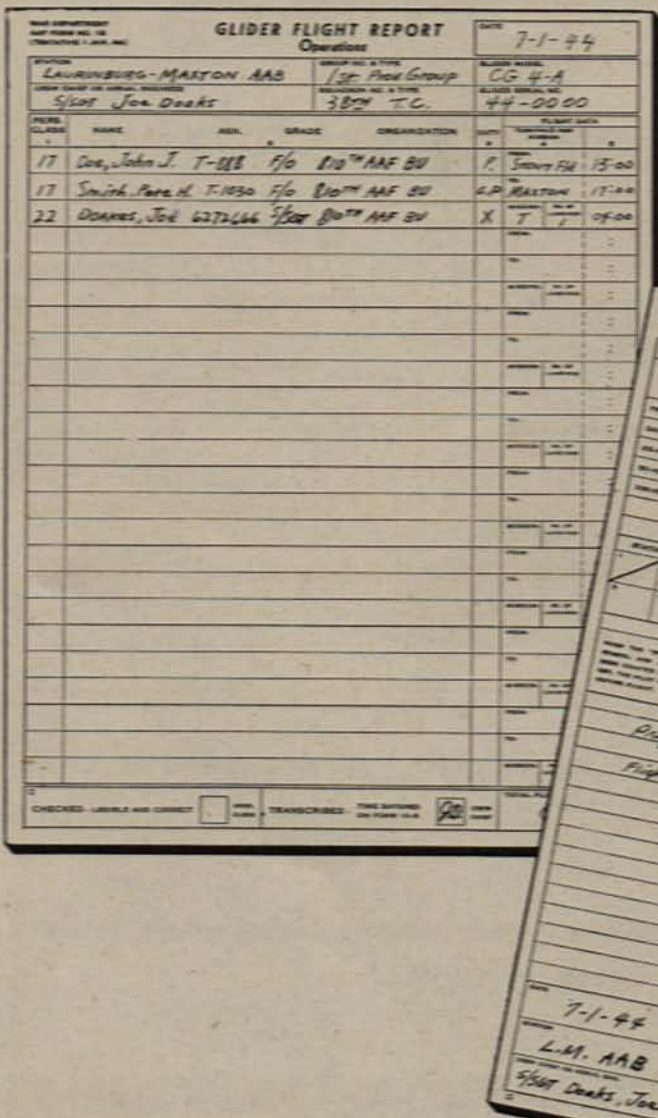
Stall Speed With designed load (7500 lbs.)	49 mph	Approx. 60 mph
Tactical Glide Speed (Landing speed) with designed load	60 mph	Approx. 70 mph
Normal Glide Speed with designed load	72.6 mph	Approx. 85 mph

Landing Run: (Room required for normal 3-point landing) 600 to 800 feet. (Ground run can be greatly shortened by using emergency stop.)

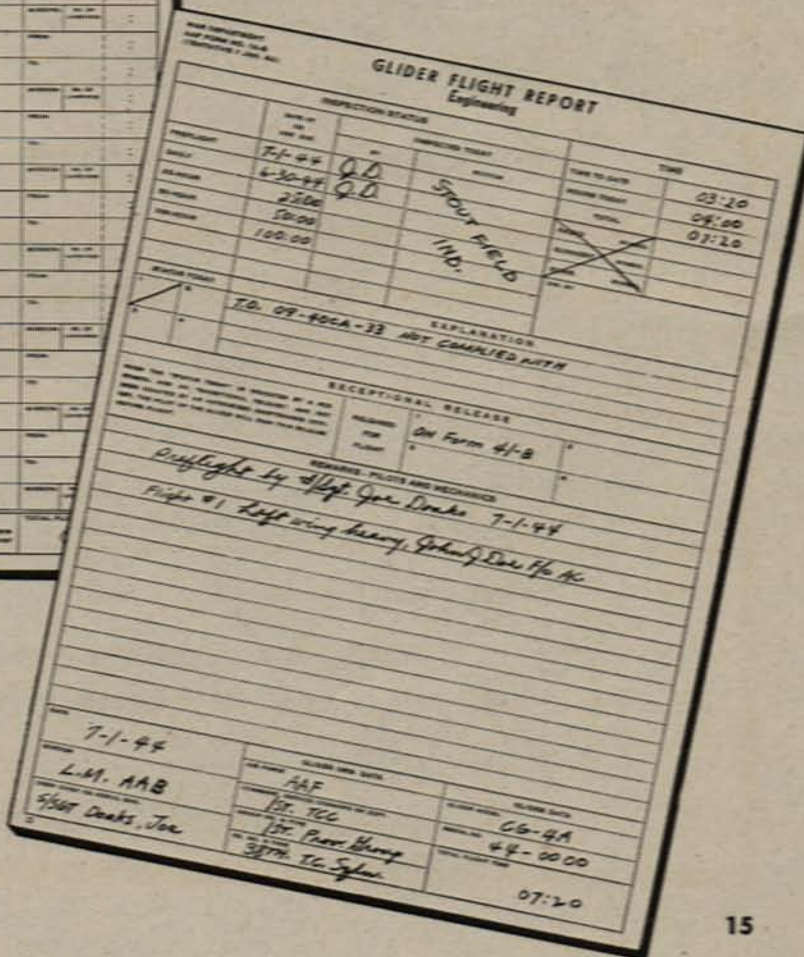
Rate of Descent (Designed Load): Approximately 400 feet per minute (at tactical glide speed).

PREFLIGHT

Inspect Forms 1G and 1A-G for completeness, noting "Status Today," "Remarks," and "Inspection Status." It's your glider until you turn it over to another pilot, and you are responsible for its condition.
For this reason, and for your own safety, make an additional visual inspection. Walk completely around the glider, using your checklist. If you note any defects not entered on the Form 1A-G, contact the crew chief. Follow the same procedure for the cockpit and cabin.



Glider forms are similar to those used for power airplanes. These illustrations should guide you in filling them out correctly.



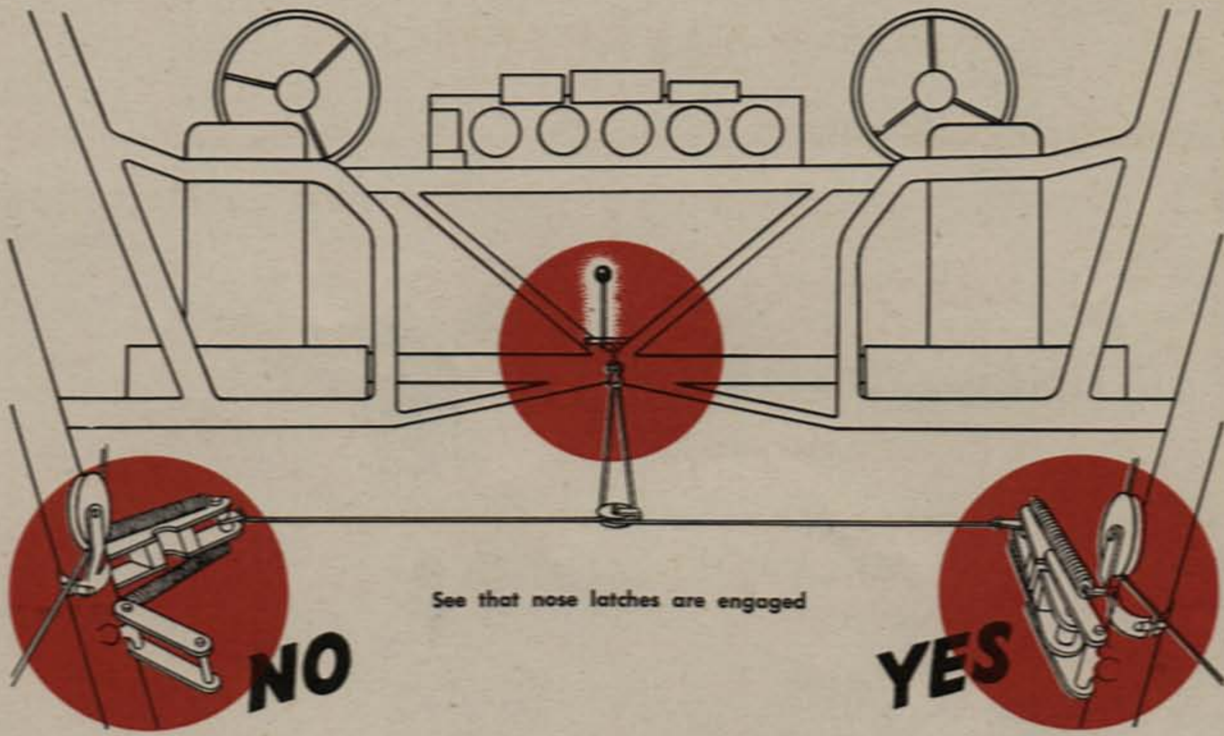
GLIDER PILOT'S CHECKLIST

I. BEFORE ENTERING GLIDER:

1. Check visually the condition of fabric surfaces.
2. Check alignment of tail brace wires and fittings. (Brace wires must be aligned to offer least wind resistance to reduce vibration.)
3. See that all flight control locks are removed.
4. See that trim tabs are in NEUTRAL position.
5. Be sure spoilers are in CLOSED position.
6. Inspect external flight control surfaces and mechanism, including aileron push-pull rods for distortion.
7. Check nose skids for damage.
8. Check landing gear, and inspect strut fittings for distortion.
9. Check tailwheel.
10. See that pitot cover has been removed.

II. BEFORE TOWLINE D-RING IS ATTACHED:

1. Check ballast, or load, for distribution and security.
2. Check doors for security, and see that emergency exits are unobstructed.
3. Check nose latch release and mechanism. See that spring-loaded latches for nose section are engaged. (See illustration.)
4. Check AAF Form No. 1G and 1A-G.
5. Check rudder pedal adjustment, and use cushions if necessary to assure comfortable position which allows full use of controls.
6. Check windshield visibility.
7. Check security of safety belt attachment, and adjust to a snug fit. (If there is a shoulder harness, test for fit and security.)



8. Check operation of all flight controls for freedom of movement and full travel.
9. Do not allow towline to be attached until all crew members are seated and safety belts are fastened.

III. AFTER TOWLINE D-RING IS ATTACHED:

1. See that tow release metering pin is flush with hex nut.
2. See that parking brake is OFF.
3. Check visually to see that ailerons are NEUTRAL.
4. Check communication with towplane (if provided).

Warning: Never leave pilot's seat after towline is attached without first releasing it and notifying ground crew.

TAKEOFF

Signals

DAYTIME HAND SIGNALS

STOP!

OPEN RELEASE

CLOSE RELEASE

TAKE UP SLACK IN TOWLINE

CLEAR FOR TAKEOFF

NIGHT SIGNALS

Towplane stops opposite designated spot for hook-up.

Towplane takes up slack after towline is attached.

Takeoff.

SINGLE TOW

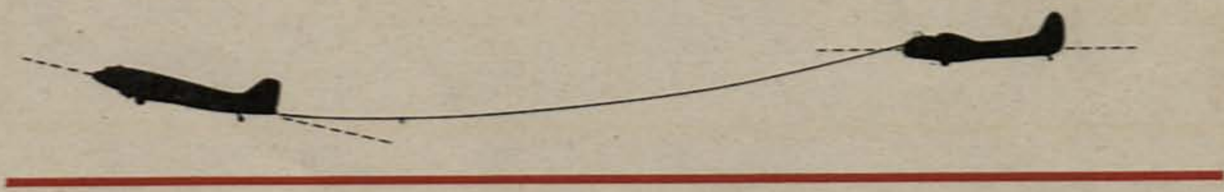
When the towline has been attached to your glider, the signal man approaches and inquires, "Ready for takeoff?" Check the parking brake releases to be sure that the brakes are off before replying, "Brakes off. All set."

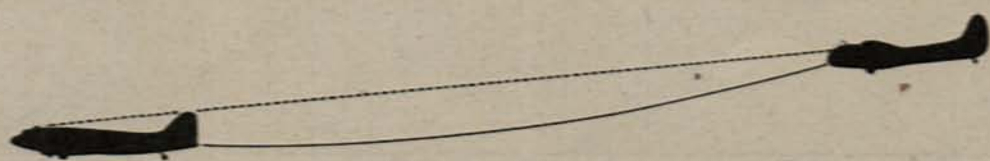
This is a standard procedure, and one you must follow to avoid the possibility of the slack being taken up while the brakes are still set. If this should happen, the rope would break and snap back, injuring anyone in its path.

1. The glider has a tendency to nose over onto the skids when slack is taken up and the towplane moves off. If the tail is lifted off the runway by the initial surge of the towline, hold back pressure on the wheel until the nose has reached a level flight position, then neutralize the elevators. Maintain this attitude through the takeoff run. Use rudder to control your direction during the run, because the drag of the brakes tends to throw the glider onto its nose skids.

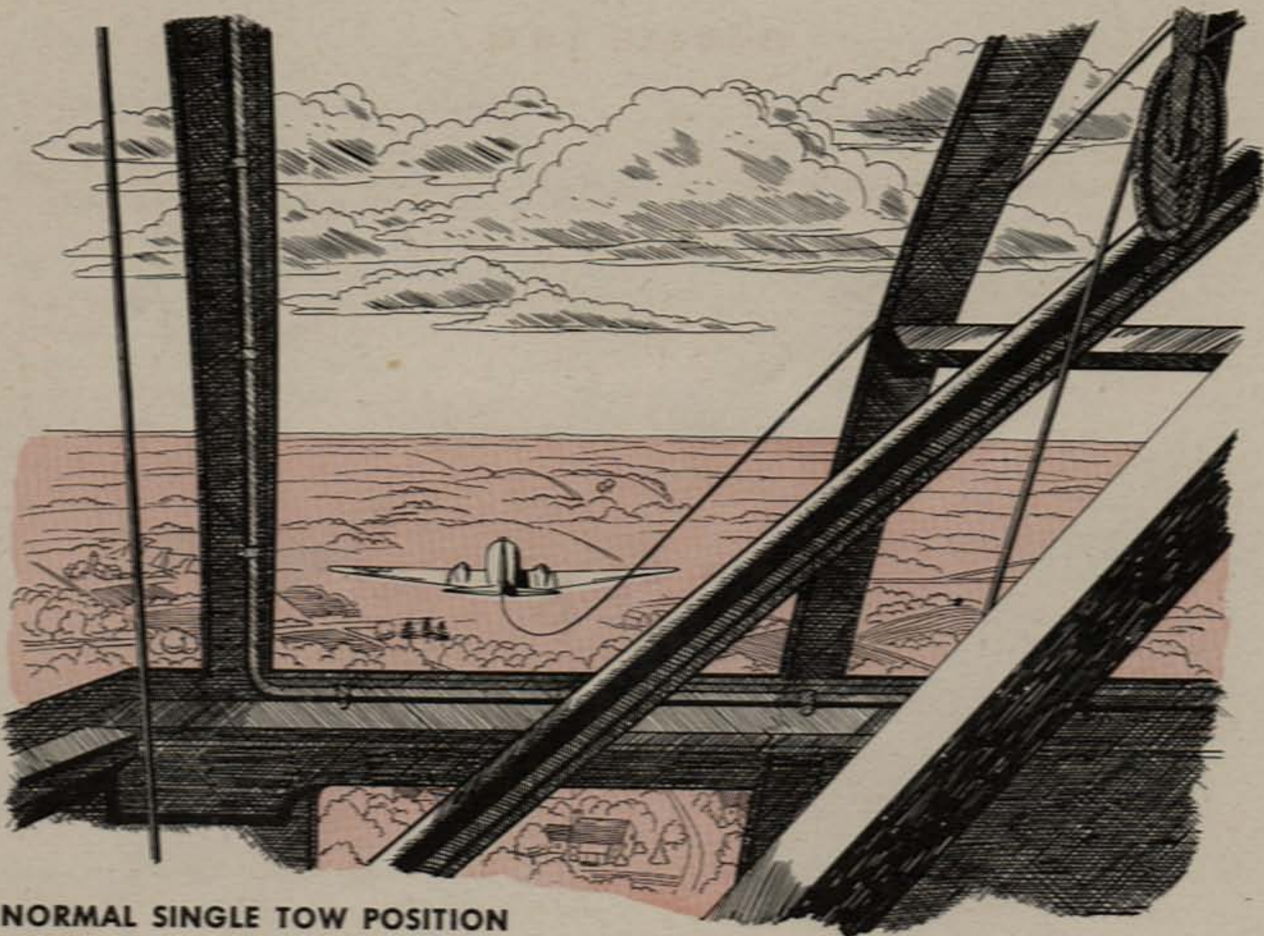
2. Take off when your airspeed is 15 mph higher than stalling speed, as estimated for your glider at its particular gross weight. If you allow the glider to float off the runway with insufficient airspeed, you do not have safe control. Yet if you hold the glider on the runway longer than necessary, you delay the acceleration of the glider train, because of the heavy drag of the glider's tires at high speed. Climb smoothly and rapidly, and level off just above the disturbed air created by the towplane (approximately 20 feet above the runway). This is necessary because disturbed air makes glider control difficult and places extra drag on the towplane. Your glider has a tendency to climb as you gain speed. A too-rapid pull-up also creates excessive drag on the towplane, making it difficult for the pilot to take off.

3. Continue a level course in this position until the towplane is airborne.



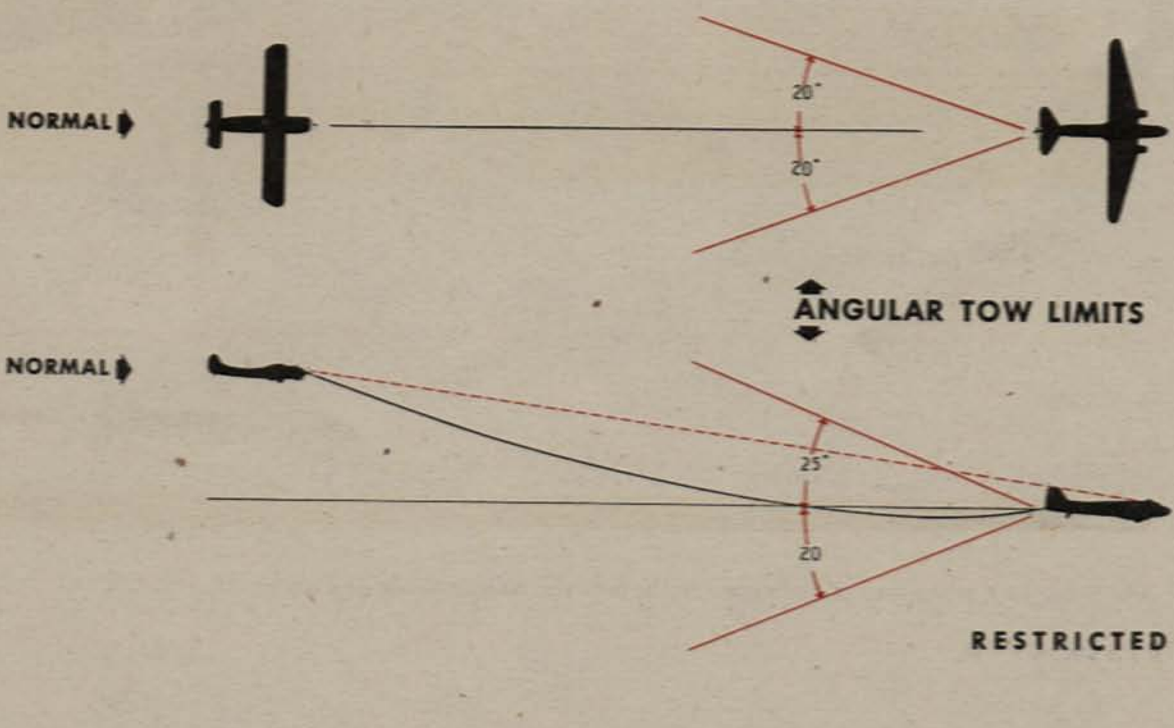


4. When the towplane is airborne, move into the tow position shown in the illustration.



NORMAL SINGLE TOW POSITION

Align tip of towplane rudder on astrodome



DOUBLE TOW

Double-tow operation requires teamwork and precision flying. You are more or less on your own while on single tow and in free flight. You line up on the towplane, trim your glider and share the trailing position with no one. On double tow you have company and additional problems. You must follow certain rules to protect yourself and the man flying on double tow with you. Follow the towplane at a prescribed angle and keep that position.

Before Takeoff

If you are flying in the long-tow position, on the right, make sure your towline is 425 feet long, or 75 feet longer than that of the glider on short tow. See that the gliders have sufficient clearance between wingtips before the towlines are attached.

The Takeoff

As the gliders start the takeoff, the towlines tend to pull them together toward the center of the runway.

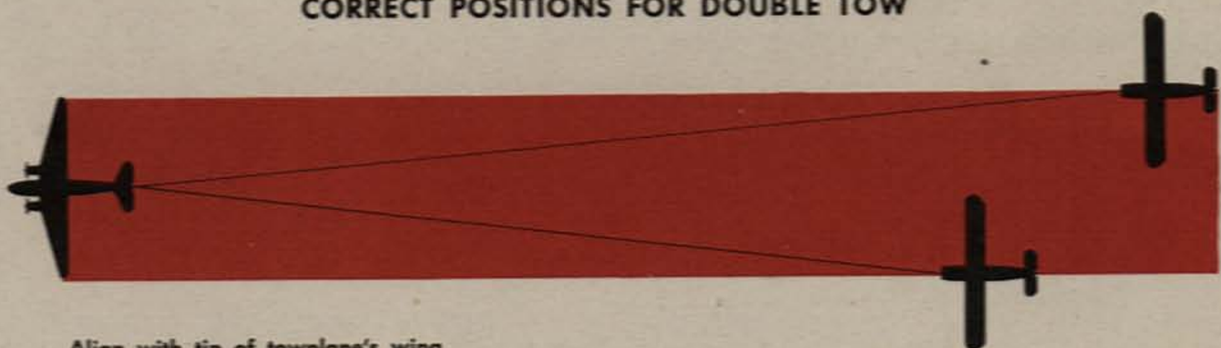
At this point, there is not enough speed to make rudder control effective, so use brakes to correct for the inside pull of the towline. When your glider has sufficient speed, use rudder instead of brakes to hold a straight roll.

The takeoff is made in the same manner as for single tow, except that you now align your glider on the wingtip of the towplane. Hold this tow position as closely as possible. If you swing out too far from the towplane, you increase the drag on it. If you swing toward a position directly behind the towplane, you endanger the glider on tow with you. Fly at the same altitude above the towplane as in single tow.

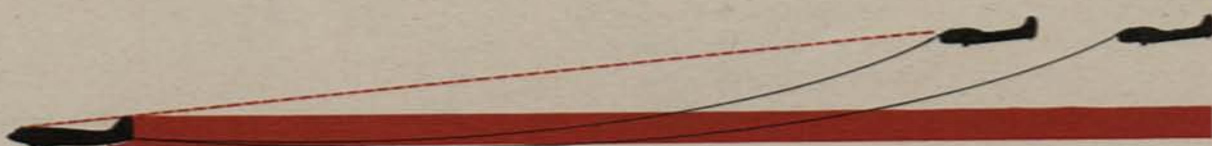
Caution

The pilot on long tow has an unobstructed view of the glider in the short-tow position, but the short-tow pilot cannot see the glider on his right. For this reason, the pilot on long tow is responsible for avoiding a collision in any emergency.

CORRECT POSITIONS FOR DOUBLE TOW



Align with tip of towplane's wing

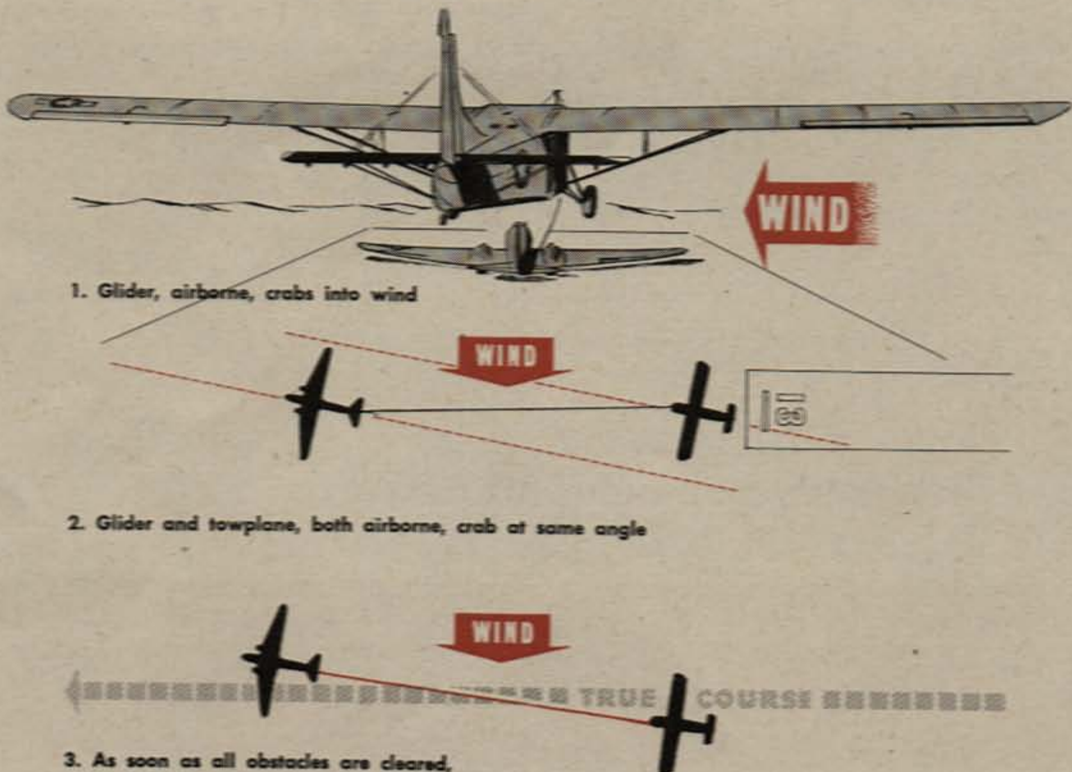


CROSSWIND TAKEOFF

Air pressure builds up readily under the upwind wing of the CG-4A in crosswind takeoffs, tending to raise the upwind wing and wheel. This causes the glider to skip sideways on the runway before it is airborne, placing severe side loads on the landing gear.

To correct, keep the upwind wing down by steady aileron pressure, and hold the control wheel forward to keep the wheels firmly on the ground. You must have greater than normal airspeed before taking off so that you can lift clear of the runway rapidly. This minimizes the danger of skipping sideways with the wind. When you have safe ground clearance continue your climb at a normal rate.

As soon as you are airborne, correct for drift by crabbing. The amount of crab depends on wind velocity and direction. Be cautious about lowering the upwind wing, because a gust may cause it to dip too low and hit the ground.



1. Glider, airborne, crabs into wind

2. Glider and towplane, both airborne, crab at same angle

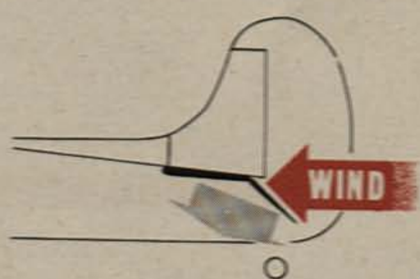
3. As soon as all obstacles are cleared, glider falls into normal position behind towplane.

DOWNWIND TAKEOFF

A downwind takeoff differs from normal takeoff in two respects:

1. A tailwind has a reverse effect on the controls. As slack in the towline is taken up, hold the control wheel full forward to keep the nose skids off the runway. Take this reverse effect into consideration in using rudder.

2. As the glider gains speed, the direction of airflow changes and you must react promptly.



FLYING IN TOW

Trim Tabs

Because the airspeed varies so much during a normal flight, it is impossible to rig the stabilizer surfaces to eliminate all control pressures. These pressures at times are excessive, hampering proper control. Therefore trim tabs, which can be controlled from the pilot's compartment, are a part of the glider's control system.

The CG-4A has three trim tab controls—one each for the ailerons, elevators, and rudder.

During the preflight check the trim tabs are placed in NEUTRAL. On takeoff, your glider undergoes fast accelerations and effective trim tab adjustment is impossible. However, control pressures are normally not great during this period. Unless the glider is extremely out of trim, don't attempt any adjustment. Gusts of wind frequently encountered during the takeoff tend to throw the glider out of position, and warrant the use of both hands on the wheel to make prompt corrections.

When you attain cruising speed, trim your glider to fly the desired course, eliminating control pressures. This greatly reduces the fatigue of a long flight.

Remember that the main function of the trim tabs is to ease the pressure on the controls and save you work. If they don't do this, the adjustments are not correct.

CONTROL REACTION

In Smooth Air

On tow the glider responds with little control pressure if the air is smooth and stable. Use aileron rather than rudder to hold your position. Slight aileron movements do not require compensating rudder pressure, because the towline exerts a steadying influence, tending to hold the glider in a straight path.

Practice flying with your feet off the rudder pedals while on tow. This enables you to relax, especially on long cross-country flights.

Oscillation

If the glider gets out of position, ease it back smoothly. Sudden, excessive aileron corrections on tow cause oscillation, or a pendulum-like swing of the glider from side to side. The pilot, not the glider, is responsible for oscillation.

Oscillation results when the pilot, trying to regain proper tow position, overcorrects. If the glider is out of position to the right, for instance, the pilot overcontrols to return it to a position behind the towplane. His overcontrol causes the glider to swing to the left, past normal position, and into an extreme attitude to the left of normal tow. This pendulum-like swing continues as long as the pilot overcontrols.

This is how you correct for oscillation:

As soon as the glider moves toward the normal position, begin neutralizing the controls. This slows the speed of the movement and permits you to stop the swing when the glider reaches the correct position.

In Disturbed Air

When any aircraft encounters air disturbed by prop wash or wing wake of a preceding airplane, it experiences a loss of lift and control.

When this happens with the CG-4A, you feel it mushing down, and one wing may begin to drop. Use of rudder and aileron to lift the falling wing has no effect.

To correct, move either up or down into clean, undisturbed air where you feel normal control.

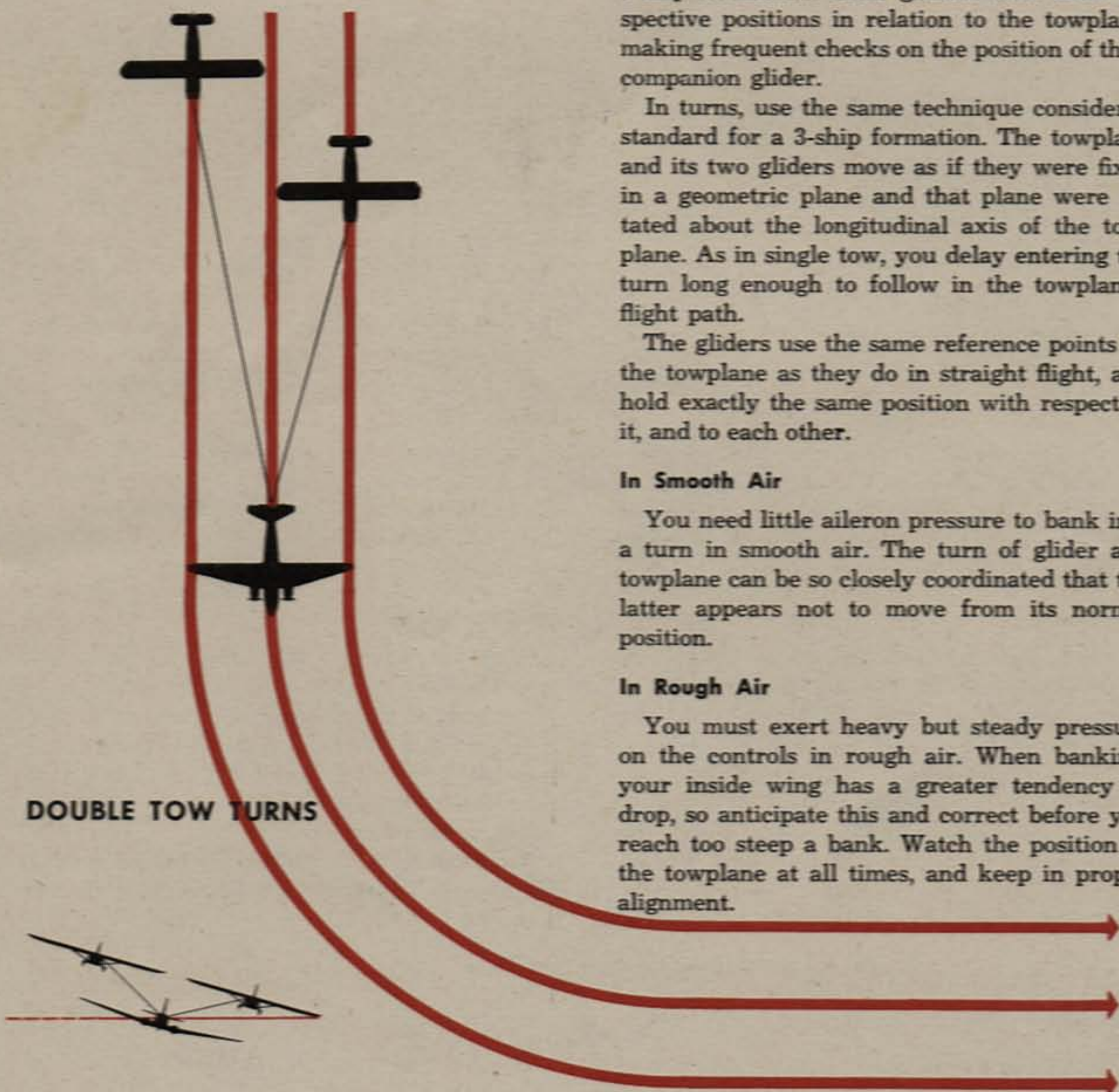
Overcontrol of glider results in oscillation

TURNS IN TOW

Single Tow

While in tow you must fly formation on the towplane. In turns, this fact is emphasized.

Because your glider is 350 feet behind, you start your turn a second or so after the towplane does so that you actually follow the same flight path. Use the same reference points on the towplane in the turn as in level flight.



DOUBLE TOW TURNS

In medium or steep turns the towline tends to pull the nose of the glider toward the direction of the turn. Use top or outside rudder to correct. Check the bank indicator to maintain a coordinated turn, centering the ball. When you have established the proper bank, the wing continues to drop unless you stop it.

Double Tow

In double-tow operation you actually have a 3-ship formation. Both gliders hold their respective positions in relation to the towplane, making frequent checks on the position of their companion glider.

In turns, use the same technique considered standard for a 3-ship formation. The towplane and its two gliders move as if they were fixed in a geometric plane and that plane were rotated about the longitudinal axis of the towplane. As in single tow, you delay entering the turn long enough to follow in the towplane's flight path.

The gliders use the same reference points on the towplane as they do in straight flight, and hold exactly the same position with respect to it, and to each other.

In Smooth Air

You need little aileron pressure to bank into a turn in smooth air. The turn of glider and towplane can be so closely coordinated that the latter appears not to move from its normal position.

In Rough Air

You must exert heavy but steady pressure on the controls in rough air. When banking, your inside wing has a greater tendency to drop, so anticipate this and correct before you reach too steep a bank. Watch the position of the towplane at all times, and keep in proper alignment.

TOWLINE HAZARDS

Failure of a towplane engine on takeoff or in flight may necessitate a quick release of your glider by the towpilot. Unless you anticipate such a release, the towline may foul on your glider and, catching on trees or telephone wires, drag you down in a crash. Therefore, an emergency release by the towplane is preceded by a warning signal when possible.

When the intercommunication system is connected, the towpilot uses it to warn you of the release. Because this system is not always provided, the following emergency procedures are standard:

Night Operation

Towpilot flashes red light located in astrodome. (The emergency release warning switch is on the quadrant 2 inches below the pitch control. It is used only in the foregoing emergency.) When this warning is given, immediately release your end of the towline. If on double tow, pull clear of the other glider.

Day Operation

The towpilot has no means of warning you of the release during the day, except when intercommunication is used. Therefore you must watch the towplane carefully for such signs of engine trouble as excessive smoking, backfiring, or windmilling and possible feathering of a propeller. These signs, and a sudden drop in airspeed, are your only warning. If there is a suitable landing area within glide range, release at once.

If there is no landing area near, your towpilot may elect to try to tow you to a more favorable release point. This depends on the following conditions:

Double Tow—If he can hold 800 feet or more altitude, and maintain at least 100 mph airspeed.

Single Tow—If he can hold 400 feet or more altitude, and maintain at least 100 mph airspeed.

Be particularly alert during the takeoff. The towpilot has no alternative but to release you immediately in the event of even a partial engine failure at this point.

Emergency Procedures

To minimize the danger from a towline released without warning by the towplane, follow this procedure:

Single Tow—Make a steep pull-up, straight ahead, to permit towline to fall free below your glider. When it is hanging straight down over the nose, release the towline and allow it to drop clear.

Double Tow—The towline presents a greater threat if you are on double tow. When released by the towplane it falls down and back between the two gliders. The towline attached to the nose of the short-tow glider stretches back across the right landing gear strut, and when released from the glider may blow back over the wing struts, or wrap itself around the axle. The towline attached to the glider on long tow acts similarly, but on the left side.

A sharp knife may be used to free the rope if it fouls on the landing gear or strut.

TACTICAL RELEASE

Single Tow

You are responsible for releasing from the towplane when your destination is reached. You may release beforehand only in an emergency.

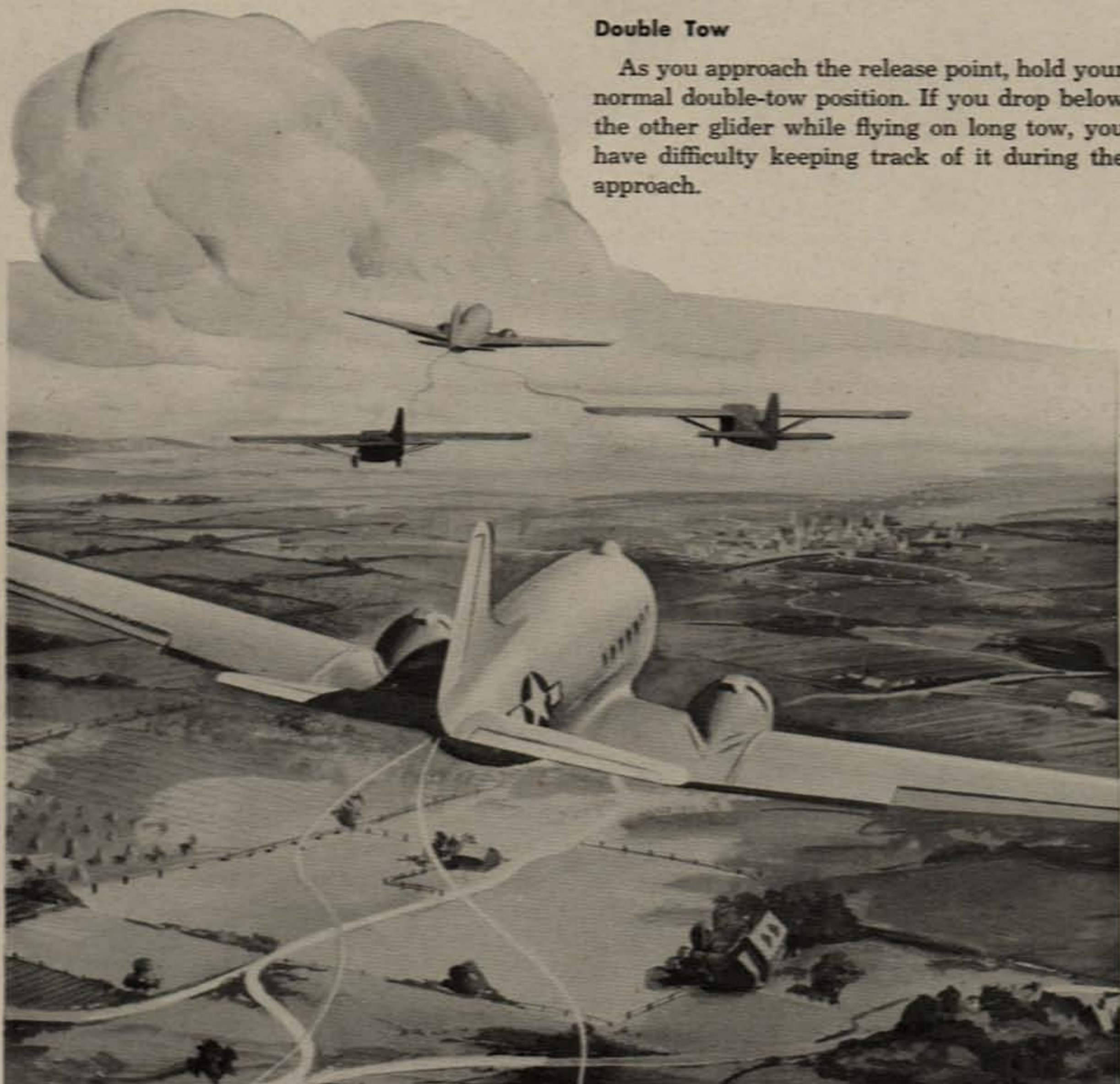
The glider tends to climb as soon as released. The reason is that you trim the nose up during tow to counteract the downward force created by the towline.

To correct, ease the control wheel forward and maintain straight and level flight until excess speed is dissipated. Then trim the glider to fly at the tactical glide speed. (See glide section, page 30.)

The reason for emphasizing straight and level flight after release is that in formation flights the overtaking towplane clears you by climbing above and to your right. This hazard is particularly great on 90° and 180° approaches.

Double Tow

As you approach the release point, hold your normal double-tow position. If you drop below the other glider while flying on long tow, you have difficulty keeping track of it during the approach.



THE GLIDE

Flight at Low Speed

Because the combat glider, in free flight, is flown consistently at airspeeds closer to the stall than is common with any other type of aircraft, you must understand a few facts of flight. The following simplified version of the theory of lift will refresh your memory.

Fundamentally the wing moves air, creating lift. The lift created is in direct proportion to the weight of air moved. There are two ways to control the amount of air moved and thus change the lift given by a particular wing:

1. Change the angle at which the wing strikes the air (angle of attack). Up to the stalling point an increase in angle of attack gives an increase in lift.

2. Change the speed of the wing through the air, and thus change the amount of air moved during any given time interval.

STALLS

Air, like water, has a sticky quality which tends to hold it in a smooth mass. Therefore, it is inclined to flow smoothly around the wing. However, it takes only so much pushing around before it rebels.

When the angle of attack is raised from a no-lift position, portions of the airstream begin to break away from the smoothly flowing mass of air and boil about the trailing portions of the wing. When the angle of attack reaches approximately 16°, so much of the air mass is boiling about and behind the wing that the lift created is insufficient to maintain flight. This is the stalling point.

Consider the stalling point in terms of angles of attack, rather than of airspeeds. Thus, stalls in turns—which occur at much higher airspeeds than in straight flight—are easily understandable.

Detecting the Approach of a Stall

In a straight glide, slight changes in angle of attack can be detected most easily by sound and feel. The pitch of sound of the airstream rushing over the glider and the feel of the controls indicate the airspeed and angle of attack.

Since stalls occur as a result of excessive angles of attack rather than because of a loss of airspeed, you can rely under all conditions on only those symptoms which indicate burbling of the air over the wing. Chief among these is the loss of effectiveness of the ailerons.

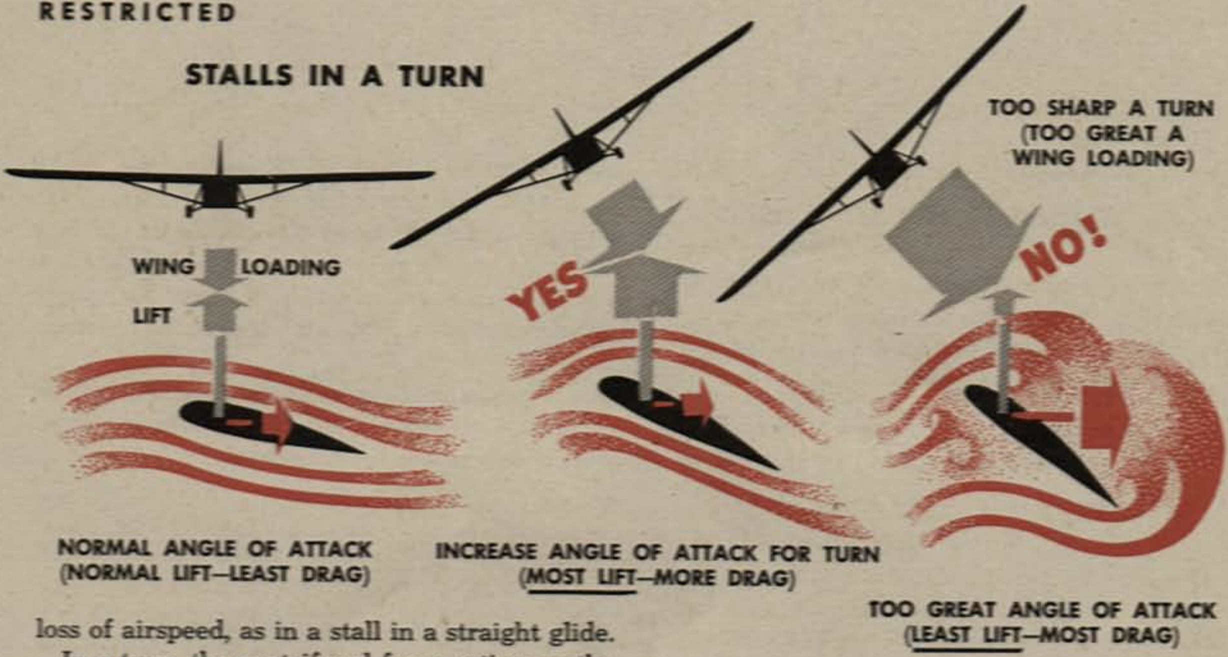
Regardless of the airspeed at which you approach the stall (as in a steep bank), the ailerons begin to feel "soft" as soon as the burble of the stall, creeping out over the wing, reaches them. You can't depend on the elevators and rudder, because they react only to a

AERODYNAMICS OF A STALL

Airflow in Tactical Glide

Airflow in a Stall

STALLS IN A TURN



loss of airspeed, as in a stall in a straight glide.

In a turn, the centrifugal force acting on the glider has the same effect on the stalling speed as an increase in the gross weight would have if the glider were in straight flight. The wing must create more lift, therefore, it must assume a higher angle of attack. Just as in straight flight, when the wing reaches its stalling angle of attack, regardless of the airspeed, it stalls. The approximate stalling airspeeds for given degrees of bank are shown in the accompanying chart.

Remember that the wing stalls in a turn because of excessive angle of attack. Therefore, to regain control of the glider you must decrease this angle and gain additional airspeed. To do this, push the wheel forward, loosening the turn. As soon as the feel returns to the ailerons, begin a normal turn recovery. Apply ailerons gently in this recovery to avoid stalling the lower wingtip and repeating the procedure.

STALL INCREASES AS BANK INCREASES
(Designed Gross Weight)

Bank Angle	Percentage of Increase	MPH Increase	Stalling Speed (IAS)
0	0	0	60 mph
10	.5	.3	60.3
20	3.0	1.8	61.8
30	7.0	4.2	64.2
40	14.4	8.6	68.6
DANGER LINE			
50	25.0	15.0	75.0
60	41.1	24.8	84.8
70	71.0	42.6	102.6
80	240.0	144.0	204.0

1. Wing close to stalling angle of attack

2. Lowering of aileron has same effect as increasing angle of attack, causing aileron stall. Wing drops instead of rising

The Aileron and the Stall

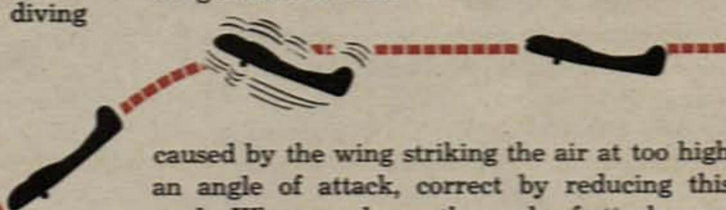
When, in order to raise one wing, you lower its aileron, for all practical purposes, you increase its angle of attack. If the wing is close to its stalling point just before you lower the aileron, you cause a complete stall of that wing. This stalling of a wing by its aileron is referred to as a reverse action of the aileron, and as an aileron stall.

The effect is particularly dangerous when you are using the last bit of excess airspeed to clear a barrier in your approach path. Under this condition, if you attempt to use aileron to raise a wing which has dropped because of a gust of wind, for example, you cause a diving turn into the ground.

Careful Coordination Necessary

You must coordinate carefully the entry into and recovery from moderate turns at slow airspeeds to maintain a "ball in the center" flight attitude. Skids and slips caused by careless handling of the controls are particularly dangerous in gliding flight because they result in sharp decreases in airspeed and lift. Heavy handling of the ailerons, with the accompanying excessive yawing induced, may completely stall the wingtips even though the rest of the wing retains its lift.

RECOVERY FROM A STALL



Since virtually all tactical glider flying is done at minimum altitudes, learn to make recovery from a stall with minimum loss of altitude.

The altitude lost after you detect a stall depends upon the wing-loading and how far you allow the stall to progress before you begin recovery. Therefore, you must recognize and react to the stall promptly. Because the stall is caused by the wing striking the air at too high an angle of attack, correct by reducing this angle. When you lower the angle of attack practically all lift is lost and the ship proceeds in a diving attitude until you gain sufficient airspeed to provide lift at this new angle of attack.

The large elevators of the CG-4A permit you to recover from the dive as soon as you regain tactical glide speed. Practice this quick recovery from the stall on a high-altitude tow, so that you will recognize the feel and sound of the glider when it may be leveled out of its dive.

Emergency Procedure: WHEN TOO LOW FOR NORMAL RECOVERY

Know the minimum altitude needed to complete recovery from a stall. When you stall below minimum altitude, it is impossible to attempt a normal recovery without crashing.

If you lower the nose, you dive and cause a serious crash. To avoid this, mush the glider in. Strike in a three point attitude to cushion your inevitable crash landing.

GLIDE SPEEDS

In making a tactical approach two factors must be given first consideration:

1. For the shortest possible landing run (approaching over an obstacle), you must approach and land at the lowest safe flying speed. The landing must be simply a continuation of the approach, without a flare-out, or floating period.

2. For accuracy in the approach to the landing spot, you must fly at that airspeed which allows you a maximum of control of the glide angle through slight changes in airspeed.

In considering the first factor, the lowest airspeed at which you can safely make the approach is that which is barely above the stall. However, at this speed you have the least control of the glider. Any attempt to increase the airspeed by lowering the nose results in a partial stalling of the wing. A loss of between 50 and 100 feet of altitude, depending upon the gross weight of the glider, should, in this event, be anticipated. In addition, a turn attempted at this speed results in an immediate stall, and a falling away on one wing, since the ship is already too close to the stall speed to permit any increase in wingloading.

Normal Glide Speed

To determine how much above stalling speed to fly, consider the normal glide. The normal glide speed is that which results in covering the greatest distance for a given loss of altitude (assuming no-wind conditions).

The normal glide is the most efficient airspeed at which the glider can be flown. For the CG-4A, at its designed gross weight, it is approximately 85 mph IAS (72.6 mph CAS).

Since the glider, at any airspeed above the normal glide, is losing altitude at a greater than normal rate, such airspeeds must be considered as diving rather than gliding speeds.

In following the standard approach patterns there is no advantage in flying the maximum distance over the ground. In planning your approach, figure on a glide much steeper, and therefore slower, than the normal glide.

Tactical Glide Speed

The glide speed which is standard for combat gliders is called the tactical glide. It is a speed approximately halfway between the stall and normal glide speeds.

Since the approximate figures for the stall and the normal glide speeds (calculated for the CG-4A at 7500 lbs. gross) are 60 and 85 mph IAS, respectively, the tactical glide speed is about 70 mph.

In playing the glide speed to obtain the desired rate of descent, you need vary your airspeed little more than 10 mph above or below the tactical glide to cover the full range of glide angles.

The use of the tactical glide gives maximum control over your glide angle, as follows:

1. To steepen your glide path, raise the nose a few degrees, decreasing the airspeed.

2. To flatten the glide path, lower the nose, increasing the airspeed.

Confusing Reactions

In playing the glide speed to control the glide angle, the desired results do not occur immediately. For example, when you raise the nose of your glider to decrease the airspeed and so steepen the glide angle, the first result is an abrupt leveling off, or even climbing, as the excess airspeed is dissipated.

Likewise, when you lower the nose to increase the airspeed and so lengthen the glide, the most noticeable immediate effect is a loss in altitude. These reactions are confusing and, unless anticipated, may make you think you have applied the wrong technique. When in danger of undershooting and the trees look close, you need plenty of will power and great faith in your own knowledge of aerodynamics to make the only correction possible and lower your glider's nose.

EFFECT OF WIND ON GLIDE

1. With no wind, assuming the final approach is started at proper altitude and point, the tactical glide is certain to end at the desired spot.

2. If, through pilot error, the glide is started from the same point, but into a high headwind, the result is as illustrated.

3. To correct for this error in judgment you must increase the glide speed (even dive, in a strong wind), thus decreasing the length of time during which the air mass can carry you away from the landing area. The excess speed of the dive is used to obtain greater distance into the wind by leveling off just above the ground obstructions, and proceeding in level flight at this altitude where the force of wind is much lower.

THE CONSTANT GLIDE

During training you are urged to maintain a constant glide speed. There are several good reasons for this. First, you have not acquired the knack of judging your glide path. To make this estimation easier (as is pointed out in the section on glide judgment), you must hold the glider's attitude as nearly constant as is practicable.

Second, you are learning to make formation approaches, staying close to and in trail of the preceding glider. To avoid complete confusion in the formation, it is necessary to hold a uniform airspeed throughout the group of gliders. The use of spoilers and slips make it possible for you to hold this standard airspeed and still control your rate of descent.

THE APPROACH

TURNS

Turns in Free Flight

Side-by-side controls used in the CG-4A present no great difficulty in normal flight. But your tendency is to climb in right turns and dive in left turns when you occupy the pilot's seat. The reverse is true when you ride in the co-pilot's seat.

Clear yourself at all times before making a turn, to avoid colliding with another aircraft. Use left turns whenever possible, since you have an unobstructed view from the pilot's seat. It is necessary at times to turn right, however, so learn to execute a right turn correctly, without climbing.

Downwind Turns

The downwind turn has acquired an unenviable reputation because an increasing number of accidents are attributed to it. However, a considerable misunderstanding exists regarding this hazard.

The most common belief is that the wind affects the airspeed of the glider. This impression is gained during downwind turns close to the ground, when the glider is approximately crosswind, and appears to hang momentarily without speed. As it enters the downwind half of the turn, the glider seems to gain speed with a rush.

Both of these apparent actions are merely optical illusions created because the pilot is watching the ground, even though he may not be concentrating on it. The speed of the glider relative to the ground is affected, but its airspeed remains constant.

If you fly it properly, utilizing sound and feel, the glider's airspeed does not vary during the turn. The difficulty arises because of an apparent rush of speed as the glider enters the downwind half of the turn. The unwary glider pilot notes this increase in speed and reacts by pulling the nose up a little higher, often causing a spin out of the turn.

There is another hazard in downwind turns which accounts for a fair number of accidents without the factor of pilot error entering the problem. The reason is this:

There is a considerable variation between the wind velocity just above the ground and at 100 or 200 feet. This gives the glider an overbanking tendency in turn, when one wing is near the ground and the other higher, in the more rapidly moving air. Gusts frequently found at low altitudes add to this effect. Occasionally the overbanking tendency is so strong, while the glider is banked in a crosswind position, that maximum control pressure does not effect a recovery.

STANDARD APPROACH PATTERNS

There are two important reasons why you follow an exact approach pattern:

First, you develop precision habits which are invaluable under the distracting conditions of combat.

Second, when a number of gliders are landing in a given area almost simultaneously, they must all follow the same flight path. Any deviation from the standard plan of approach causes confusion and accidents.

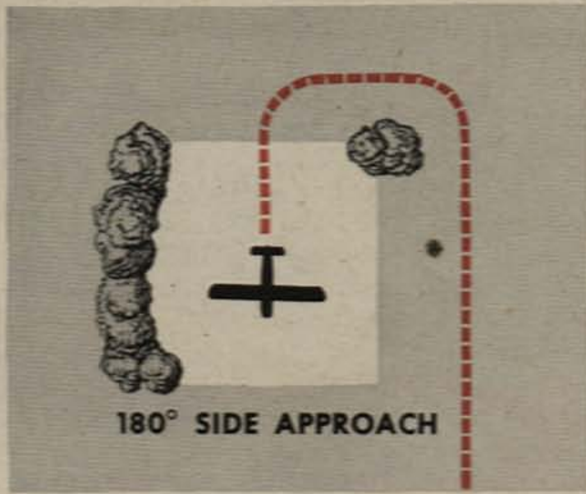
All standard approach patterns incorporate a base leg. Use it to make any final adjustments in altitude. The base leg gives you an unobstructed view of the landing area, enabling you to identify your dispersal spot so that you can make your final turn directly in line with it.

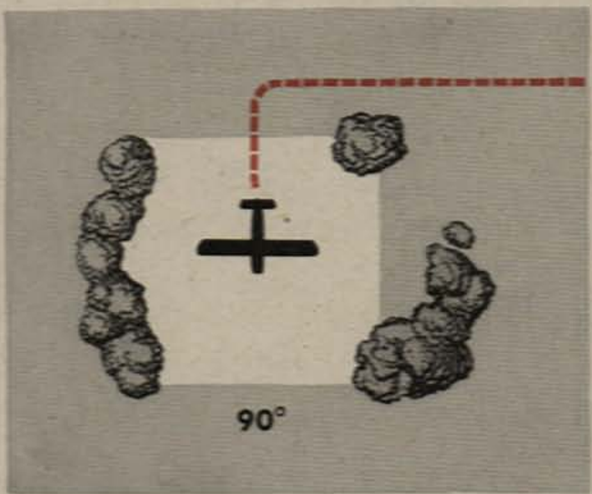
The approach patterns, as illustrated, outline the path over the ground which you must follow. In any but no-wind conditions you must crab on one or more of the headings to make good the desired course.

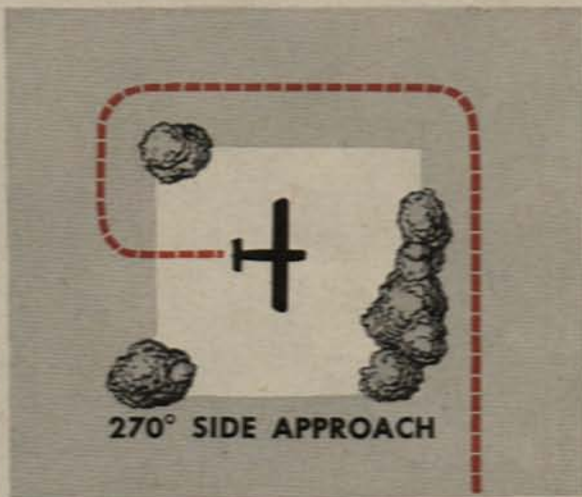
To avoid confusion in the traffic pattern, try to follow in trail of the gliders ahead of yours. However, when it appears that by following the others you will be unable to land in the proper spot, do whatever is necessary to put your glider into a more favorable position.

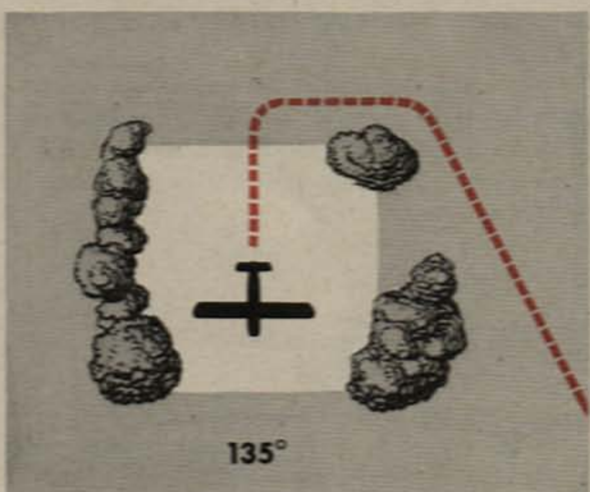
Because your judgment can't be perfect, plan your base leg close enough to the landing area to avoid the possibility of undershooting. With the proper use of spoilers and slips or tail parachute, you can dissipate a great amount of excess altitude. Remember, in gliders, altitude is money in the bank.

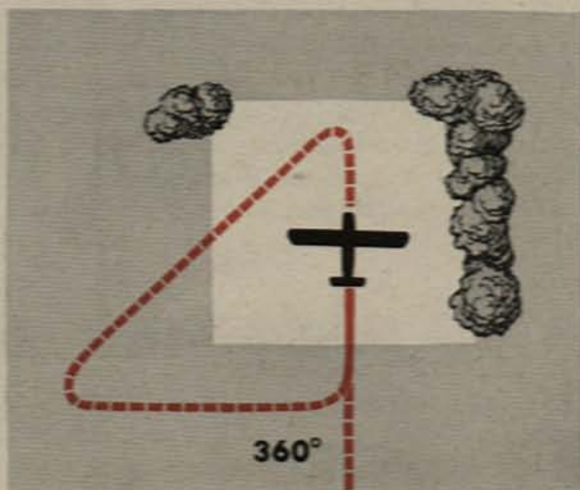
While following in trail, lead your turns by the radius of turn your glider requires. Do not make the common mistake of starting your turn after you have reached a point opposite the preceding gliders on their new leg.











USE OF SPOILERS

Most glider spoiler controls operate like the handbrake on an automobile, except that you cannot set them. It requires considerable pressure to pull the spoiler stick back, and then you must hold it in the desired position.

Because spoilers decrease the over-all lift of the wing, the nose tends to drop, causing the glider to pick up speed. Use considerable back pressure on the control wheel to compensate for this, and hold constant airspeed.

Caution: Don't release the spoiler control lever suddenly. Ease it back to closed position. A sudden release causes the glider to balloon.

Use spoilers at any time to dissipate altitude. If necessary, you may use a combination of slip with spoilers.

TAIL PARACHUTE

The tail parachute is an air brake used in the approach to lose altitude quickly or dissipate excess speed.

You use it:

1. To dissipate altitude without increasing speed when your landing approach is too high.
2. To reduce speed when your approach is low but too fast.

Rate of Altitude and Speed Dissipation

The rate of descent in a loaded glider is increased from a normal 400 feet per minute to between 700 and 1000 feet per minute by using the tail parachute. Higher rates of descent may be obtained in an emergency by increasing the airspeed above the range of glide speeds.

The glider can be decelerated from 120 mph to 70 mph IAS in less than 30 seconds by using the tail parachute.

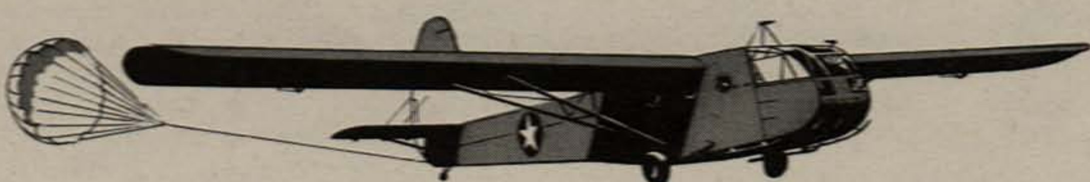
How to Operate

Never release the parachute while the glider is on tow.

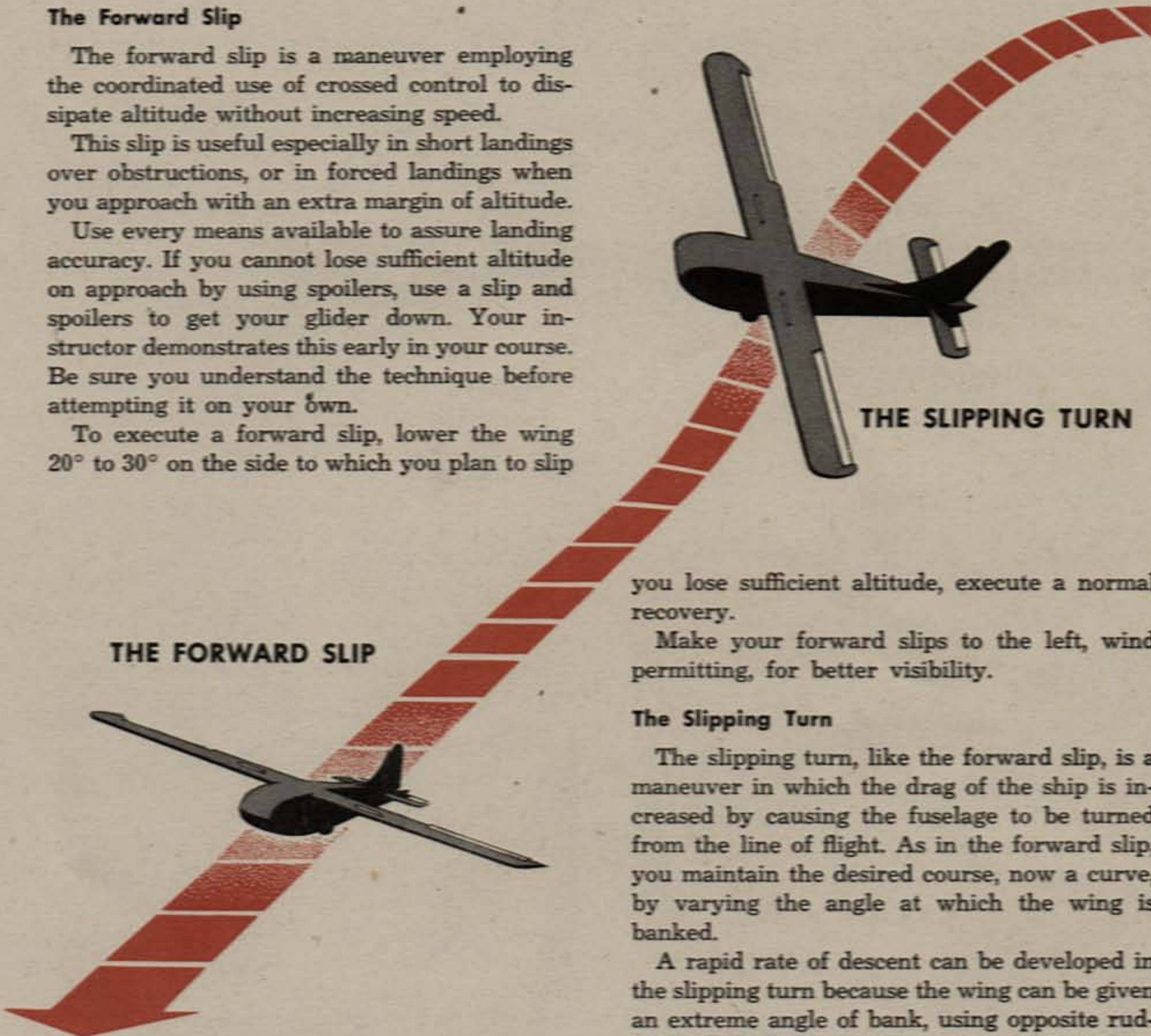
The maximum airspeed tor release of the parachute is 140 mph.

A tugging, oscillating sensation accompanies the opening of the 'chute at high speeds. This does not hamper control, however, so don't be alarmed.

When you have released the 'chute, be prepared to jettison it if the descent is too rapid and the approach short. If you have a copilot, order him to stand by to pull the release handle when necessary.



SLIPS



The Forward Slip

The forward slip is a maneuver employing the coordinated use of crossed control to dissipate altitude without increasing speed.

This slip is useful especially in short landings over obstructions, or in forced landings when you approach with an extra margin of altitude.

Use every means available to assure landing accuracy. If you cannot lose sufficient altitude on approach by using spoilers, use a slip and spoilers to get your glider down. Your instructor demonstrates this early in your course. Be sure you understand the technique before attempting it on your own.

To execute a forward slip, lower the wing 20° to 30° on the side to which you plan to slip as you apply full opposite rudder. Use aileron to control the direction of flight. Hold constant speed during both the slip and recovery, and avoid a tendency to let the nose drop. Unless you keep the glider in a nose-high attitude, you lose little altitude. Also, avoid sudden release of the rudder in recovery, since this allows the nose to swing down and increases speed. When you lose sufficient altitude, execute a normal recovery.

Make your forward slips to the left, wind permitting, for better visibility.

The Slipping Turn

The slipping turn, like the forward slip, is a maneuver in which the drag of the ship is increased by causing the fuselage to be turned from the line of flight. As in the forward slip, you maintain the desired course, now a curve, by varying the angle at which the wing is banked.

A rapid rate of descent can be developed in the slipping turn because the wing can be given an extreme angle of bank, using opposite rudder to compensate.

Because descent is so rapid, and recovery from the steep angle of bank is slow, never hold the slip below 200 feet, except in emergency.

As in forward slips, use spoilers during the slipping turn. The loss of lift caused by the spoilers makes it unnecessary for you to put the glider in a bank as steep as is otherwise necessary, and thus recovery is easier.

BE *Cautious* ABOUT USING THE SLIPPING TURN UNDER EMERGENCY GROSS WEIGHT CONDITIONS.

GLIDE JUDGMENT

The main difference between a landing in a glider and one made in an airplane is that in the glider you are entirely on your own. With no engine to rescue you from an error in judgment, you must be right the first time.

Distance and Altitude

The first requirement for accuracy in landing is the ability to judge distance—distance in two dimensions: Horizontally, over the ground; vertically, to the earth.

You must be able to judge distance in order to plan your approach pattern (placing the various legs to give the best view of the landing area, and avoiding the pitfalls of the long final approach, with its danger of undershooting, or the equally fatal low final turn).

In estimating distance over the ground you make a mental comparison of the apparent size of the objective with objects near you.

In estimating altitude there are no such intermediate points with which to compare the apparent size of the objective. The ability to judge height above the ground depends upon two factors:

First, make a comparison of the apparent size of trees, houses, and roads with a mental picture of the actual size of those objects.

Mentally compare perspective and size of objectives with their actual size.

Second, judge your altitude by the angle from which you are viewing certain objects. This factor, called perspective, becomes extremely valuable during the final approach, when a slight change in altitude results in a large change in the angle of view.

The application of these factors with maximum accuracy requires a great deal of practice and experience. You must bear in mind, however, that the important thing in estimating altitude is not the number of feet in the distance, but the amount of maneuvering you can do (distance you can travel) before reaching the ground.

Constant Glide

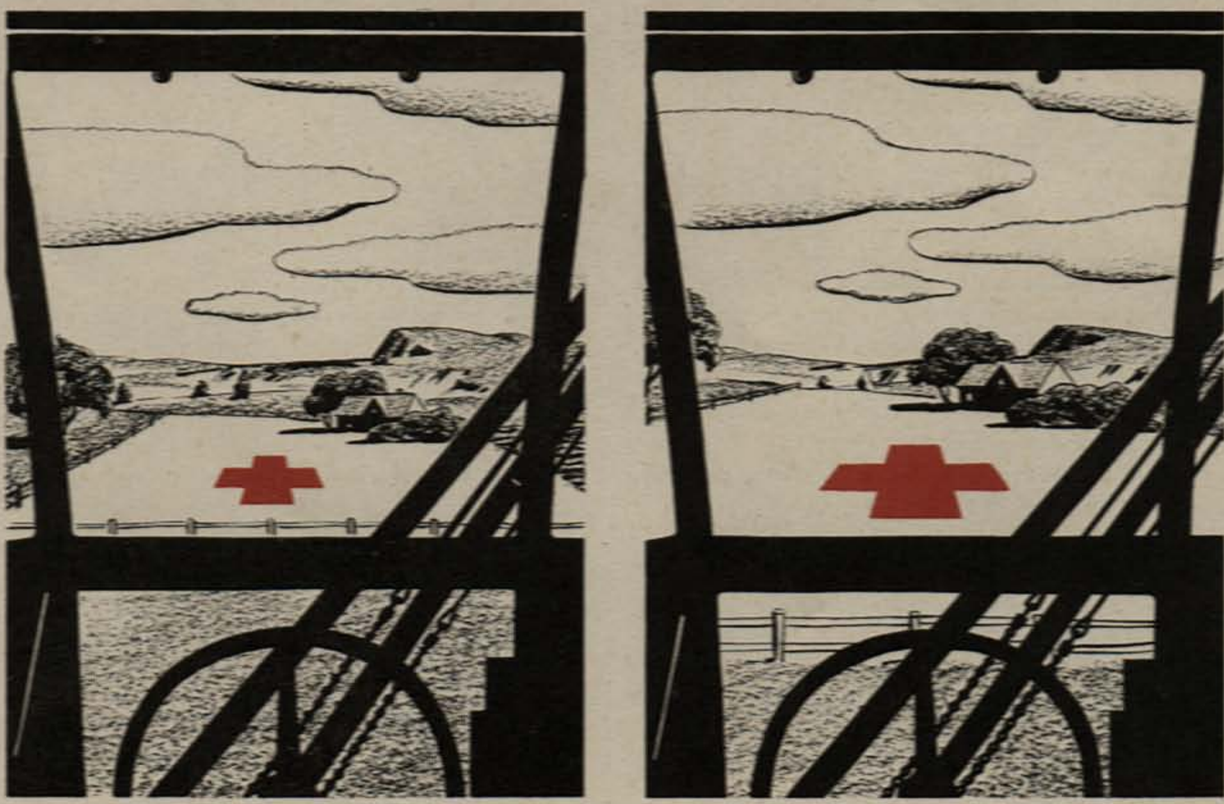
The constant glide is vital in that it permits you to judge the effects of wind on your course and provides a steady platform for visually determining the landing spot during the final approach.

As illustrated, assuming that a constant glide is maintained, the point at which you are to make contact with the ground appears to remain fixed in your windshield. Points which will be ahead of you when you land appear to move up, while those that will be behind appear to move down in relation to the canopy through which they are viewed.

A natural and dangerous tendency is to concentrate on the obstruction over which you intend to land. This concentration leads you to keep the barrier steady in relation to the windshield by controlling your rate of descent with spoilers and slips. The glide path thus maintained ends in the barrier, instead of safely over it.

To avoid this error, plan your approach by measuring visually the distance from the dispersal point to the spot at which you must touch down. Keep this spot in mind and shoot for it, rather than any obstruction in your path.

A CONSTANT GLIDE MAKES LANDING ACCURACY SIMPLE



THE LANDING

When you have established a tactical glide, little control is necessary to effect a 3-point landing. A proper landing is merely the continuation of the tactical glide.

Always check brake pressure before landing by depressing the toe pedals. A soft, spongy action denotes air in the system and poor brake action. If brakes are not firm, plan the landing accordingly.

Wait until the aircraft touches the ground, ease the control wheel back, and continue a straight roll. Use full rudder, and brakes when necessary, to control your ground run.

Learn now to hold a straight roll on landing. This is particularly important in mass glider landings, where proper dispersal depends on each pilot's ability to stay in the area assigned to him.

DOWNWIND LANDING

The downwind landing cannot be considered as an emergency measure because it is seldom possible to plan mass glider landings so that all gliders make their final approaches upwind.

The high groundspeed resulting from the approach downwind is the chief hazard. This excessive groundspeed results in a longer ground run than usual. The emergency stop can prove dangerous. Placing the nose skids on the ground at the higher speed, coupled with the overturning force resulting from the wind striking the lower surfaces of the fuselage and empennage, may force the glider over onto its back. Keep this in mind when making a downwind landing.

CROSSWIND LANDING

Your problem in crosswind landings is to maintain a straight approach path to the desired landing spot, and to avoid subjecting the landing gear to side loads caused by drift.

There are two basic methods which accomplish this, and a third technique which combines the best features of both. The latter serves the glider pilot to best advantage.

Method No. 1:

Lower the upwind wing slightly to slip the glider just enough to compensate for drift. Straighten out just before contact with the ground.

Disadvantages: A strong wind makes the method impractical because the span of the wing is too great to permit much angle of bank at low altitude.

Method No. 2:

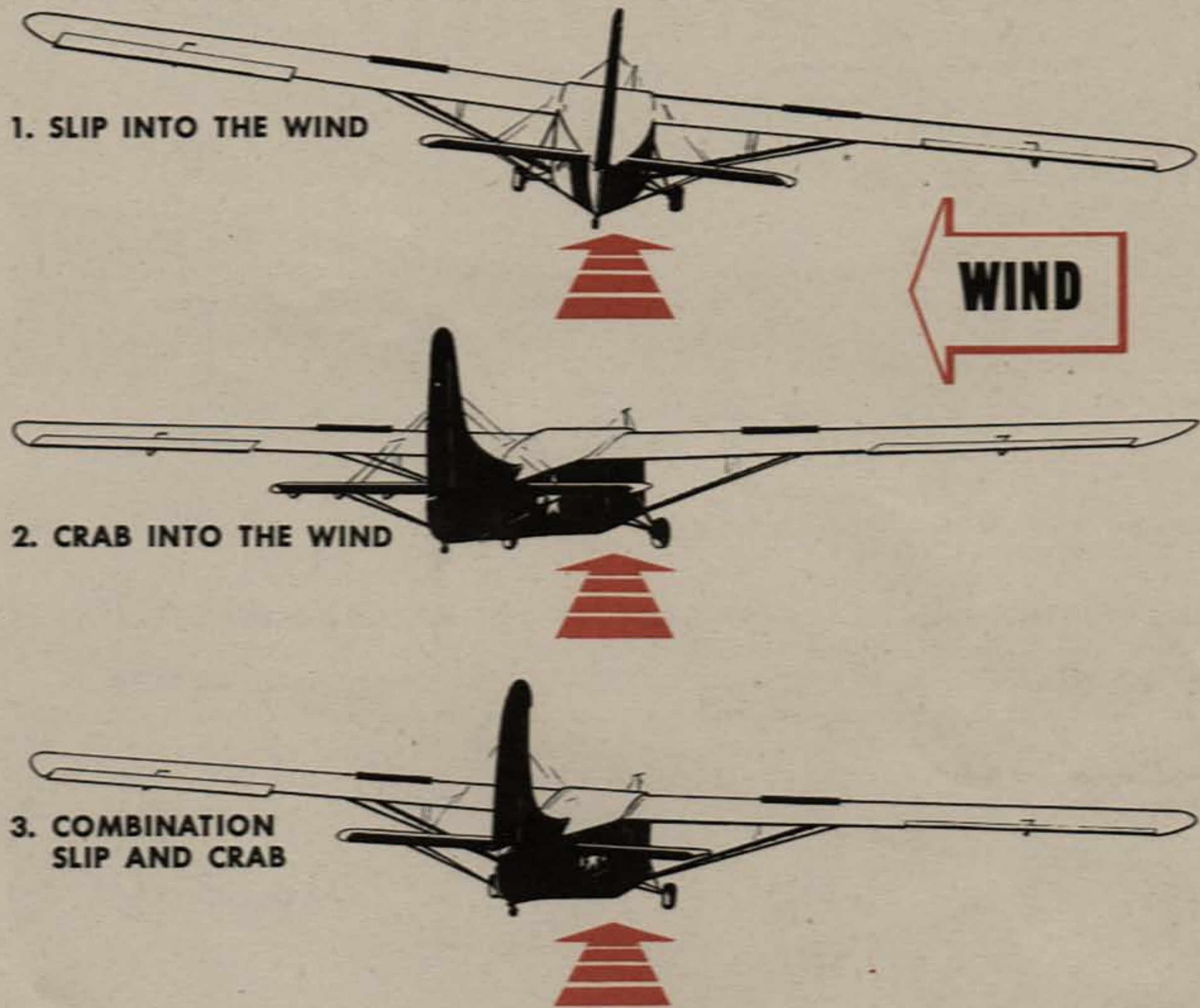
Crab, or head the glider into the wind, just enough to counteract the drift. An instant before contact, rudder the glider into the direction of the landing run.

Disadvantages: The long, heavy wings make it difficult for the pilot to swing the glider into position rapidly at the last minute.

Method No. 3:

Combine the crab and slip method. Crab only slightly into the wind, and lower the upwind wing just enough to compensate for drift.

Advantages: The landing can be made in a strong crosswind without lowering the wing to a dangerous degree. You experience less difficulty in ruddering the glider into a straight position at the last minute.



EMERGENCY STOP

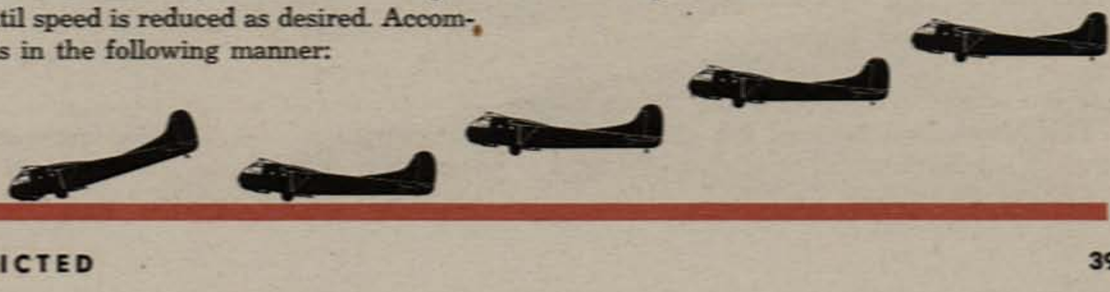
The glider's ability to land in small fields and stop in less than 600 feet is simplified by use of special nose skids which are used to brake the aircraft in emergencies.

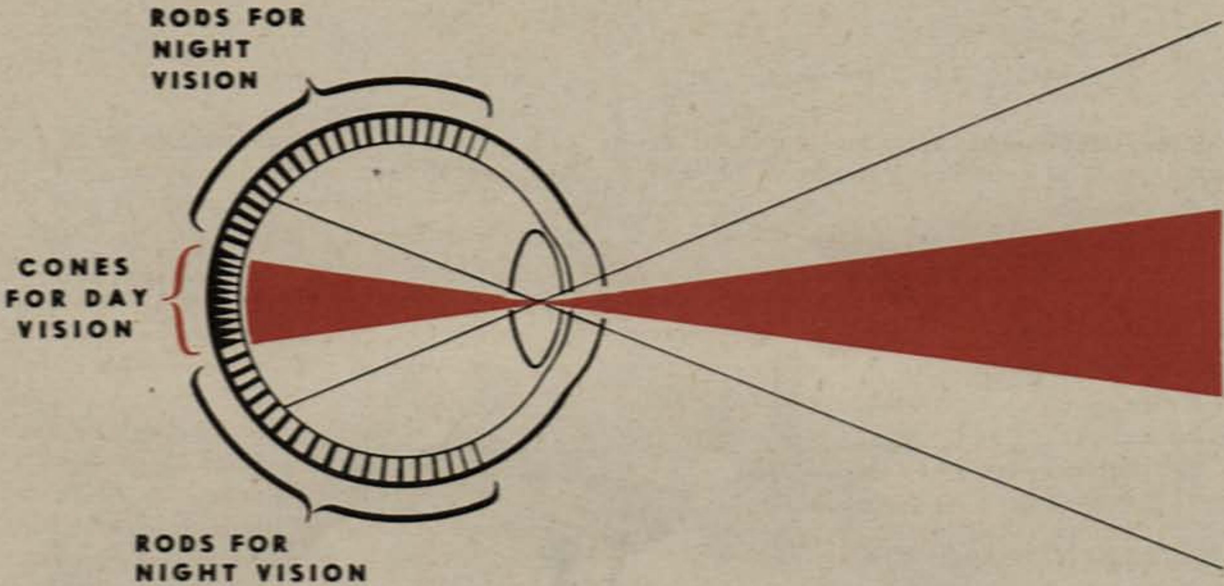
You perform an emergency stop by nosing the glider over onto the skids and holding it there until speed is reduced as desired. Accomplish this in the following manner:

First, apply brakes evenly after the glider lands.

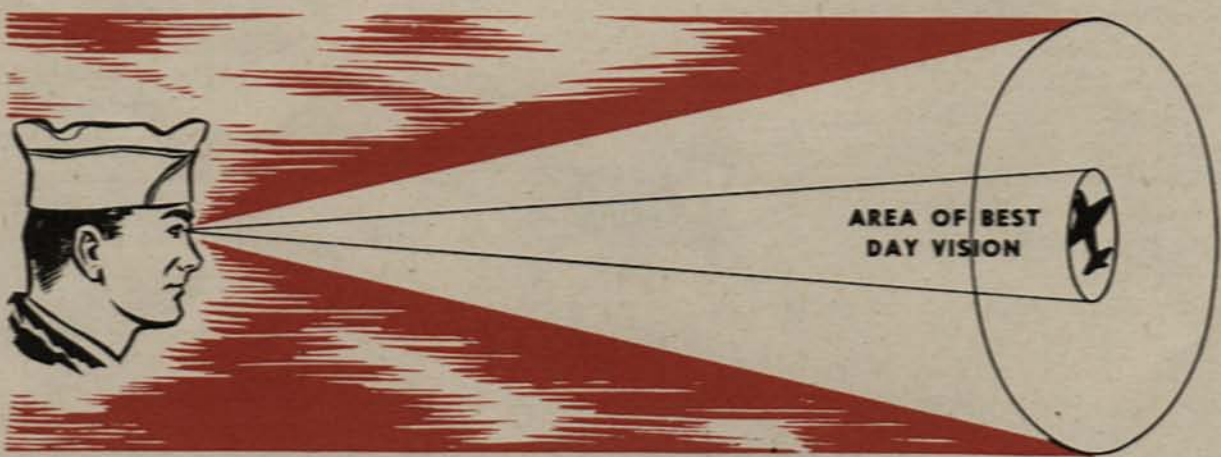
Second, ease the controls forward until the nose skids strike the ground.

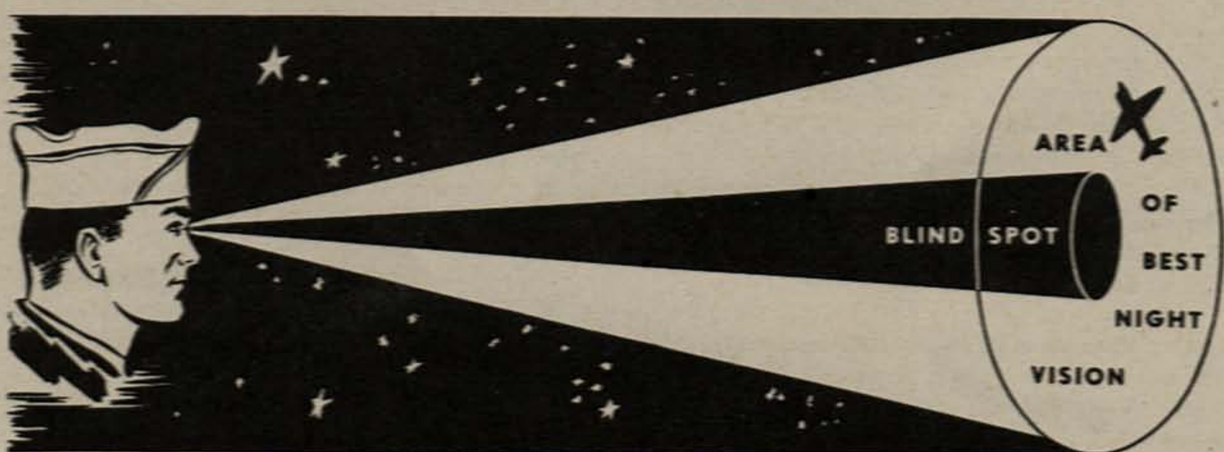
The combined action of skids and brakes causes rapid deceleration.





TO SEE AN OBJECT CLEARLY AT NIGHT DON'T LOOK DIRECTLY AT IT





NIGHT FLYING

Since most combat missions are flown at night, much of your flying from now on will occur after dark.

Your glider has a 12-volt battery for navigation lights, a landing light which operates for not more than 5 minutes, and cockpit lights. Navigation lights are used during night training, the landing light only in emergency, and the cockpit lights only while you're on the ground.

For this reason, learn to get the most out of your eyes at night. Here are a few tips:

1. Vision at night differs from day vision because you use different parts of the eye. You use a relatively small bull's-eye area of the retina at the back of the eye for most of your day vision. This area is filled with tiny organs, called cones, which enable you to make out color and fine detail by looking directly at an object in bright light. But you also see objects to one side with the outer area of the retina, which contains few cones but many rods.

These rods do not register color or detail, but do register movements of objects and picture them in different shades of gray.

The bull's-eye area is the most efficient part of the eye for day vision but is 1000 times less sensitive in dim light than the rods in the outer area of the retina. Thus, in bright or normal light, one part of your eye is doing most of the work, and in dim light another part of the eye does most of your seeing.

Since the bull's-eye part of your eye is inefficient in dim light, you have what amounts to a blind spot of 5° to 10° in the center of your vision when you look directly at a point or object at night. That's why you can see a thing much more clearly by looking slightly to one side of it. The best way is to pass your eyes slowly back and forth across the points or areas you are observing. It's easier to move your head slowly than to move your eyes. And don't concentrate on any one thing. Look out both sides of the greenhouse, keep your vision shifting, and always view objects off-center. You will find that you can greatly improve your night vision by practicing off-center glances at objects in dim light outdoors at night.

2. Adapt your eyes to darkness before you fly. Don't expose them to a bright light for 30 minutes before you take off on a night flight.

3. Keep all lights in the aircraft turned out while flying. Learn to fly by **feel** and **sound.**

4. Eat foods rich in Vitamin A—eggs, butter, cheeses, liver, apricots, peaches, carrots, squash, peas, and especially cod-liver oil and all types of greens.

5. Keep windows scrupulously clean and free from scratches. Such imperfections distort vision and create deceptive reflections.

NIGHT TAKEOFF

At night the runway lights make height and distance deceptive to the pilot with limited night flying experience. Remember to maintain straight and level flight after getting above the towplane's prop wash on takeoff so that it will be easier for the towplane to take off.

The wing and tail lights of the towplane give you an indication of its attitude and warn you when it banks for a turn. The tail light, because of its low position, may give you the impression that you are too high. Practice corrects this illusion. If the horizon is visible, compare the towplane lights with it for proper position.

Don't confuse the towplane lights with ground lights, or those appearing on the horizon.

If you lose sight of the towplane at night, immediately level your glider by checking the ground and skyline, and then fly in the direction indicated by your towline. If necessary, lower your glider to a point where you can see the exhaust flame of the towplane.

ILLUSIONS AT NIGHT

The confusion which attends night flying results from several factors. Two of them are dealt with here:

Autokinetic Movement

Autokinetic movement is suspected in the accident deaths of a number of pilots. It is important that you understand it.

If placed in a dark room and told to stare at a fixed point of light, you soon would report that the light appeared to be moving. This optical illusion increases until the light appears to be swinging through irregular arcs of considerable size. This apparent movement of light, or illusion, is known as autokinetic movement.

This movement, though irritating, is not too dangerous in itself. However, it is likely to lead to a second and more serious condition.

For some time, hypnosis has been induced by instructing the subject to stare at a fixed light. The subject finds himself watching it with a dreamlike fascination, and soon he loses contact with his surroundings, and forgets what he was trying to do.

The glider pilot, staring at the tail light of the towplane on a dark night, is in much the same position. He experiences the autokinetic movement which induces a sort of hypnotic state.

Actual cases exist where the glider pilot thought he observed the towplane performing violent maneuvers while he was in tow. In some instances, the pilot even released and crashed.

To avoid, or correct for, this illusion, swing the eyes from one visible object to another. Keep calm, and follow the known reference points for correct tow position, regardless of what your confused senses may tell you.

Vertigo

Every pilot is familiar with vertigo—dizziness in flight. Few know what causes it, and what precautions to take when affected. The brief explanation below will simplify it for you.

The seat of the sense of balance is the inner ear where there are three semi-circular canals at right angles to each other. These canals correspond to the three axes of rotation.

They are filled with fluid. Sensitive hairs extend from the walls of the dilated ends of the canals into the fluid. When the head tips or moves from side to side, the liquid in the canals, because of inertia and the force of gravity, attempts to stay in its original position.

Move or tip a glass of water and you will see that the water tries to stay put in its relation to the earth and to the points of the compass.

The same thing happens to the liquid in the inner ear, and any movement of the head sets this fluid in motion and in turn tips the hairs in the liquid so that the movement and the resulting position are telegraphed to the brain. If the movement is slow, there may be no sensation of turning at all. This fact is of extreme importance in blind flying.

If a rapid movement is suddenly slowed or stopped, the inertia of the liquid causes pressure against the opposite set of hairs and thus a false sensation of movement in the opposite direction is produced.

Take a glass of water, rotate it rapidly, then stop the glass and watch the liquid continue to rotate.

The same thing goes on in your inner ear. It is the basis of vertigo, but not the only cause. Your other senses also contribute to it.

The sense of balance is a combination of what you see and what you feel (pressure on your feet, joints, or muscles, etc.) and what your inner ear tells you. If what you see and what you feel contradict what your inner ear tells you, your brain becomes confused—it doesn't know which to believe. That confusion is the cause of vertigo.

The confusion resulting from vertigo naturally affects your flying technique, particularly at night, or when visibility is poor. Since you cannot trust your sense of feel (balance) you are inclined to do many queer and hazardous things.

When you sense vertigo, remain calm and follow the towplane in correct position. Do not let your confused senses fool you into thinking that the towplane is making some abnormal maneuver.

DISCIPLINE

The well-disciplined pilot, like the conditioned ground soldier, responds under combat conditions to lessons learned in training.

Discipline is essential for teamwork, and teamwork is vitally important in any glider mission.

In daylight missions, gliders are bunched closely in the landing pattern, often at intervals of less than 400 feet. To eliminate confusion at the landing area, all details of the pattern and dispersal are worked out carefully beforehand. If one glider gets out of position it may disrupt the entire operation. Therefore, each pilot is required to follow orders implicitly and hold his position.

Discipline in night formation flying is even more important than for day formations, because any variation in the approach, leading to intersecting flight paths, invites accidents. This is true also in following the dispersal plan.

FLIGHT FORMATIONS

Formation flying, like infantry drill, enables a commander to move his command in an orderly manner from one place to another, from which dispositions for combat may readily be assumed.

It provides for concentration of the maximum number of gliders over the objective at one time with the minimum of confusion. Formation flying demands a high degree of proficiency and discipline.

BRIEFINGS

Briefings provide the information necessary to perform an operation either in training or combat.

In training, the briefing gives your instructor an opportunity to explain the operation to be covered in a particular training period. In combat, its function is to familiarize you with every phase of the mission you're to fly, including the hazards you may encounter.

The briefing, in either case, allows time for a discussion of takeoff and landing directions, altitudes, formations, weather, landing patterns, loads, etc. It also affords an opportunity for synchronization of watches with operations time.

The importance of the briefing cannot be over-emphasized.

Pay strict attention during all briefings.

Ask questions when you don't understand a point.

Don't depend on your buddies to supply you with information covered in a briefing.

Carry a notebook at all times, and take notes at briefings. Don't rely on your memory. You'll get more out of the briefing by taking notes, and will have a reference book to which you can refer later.

GLIDER PICK-UP

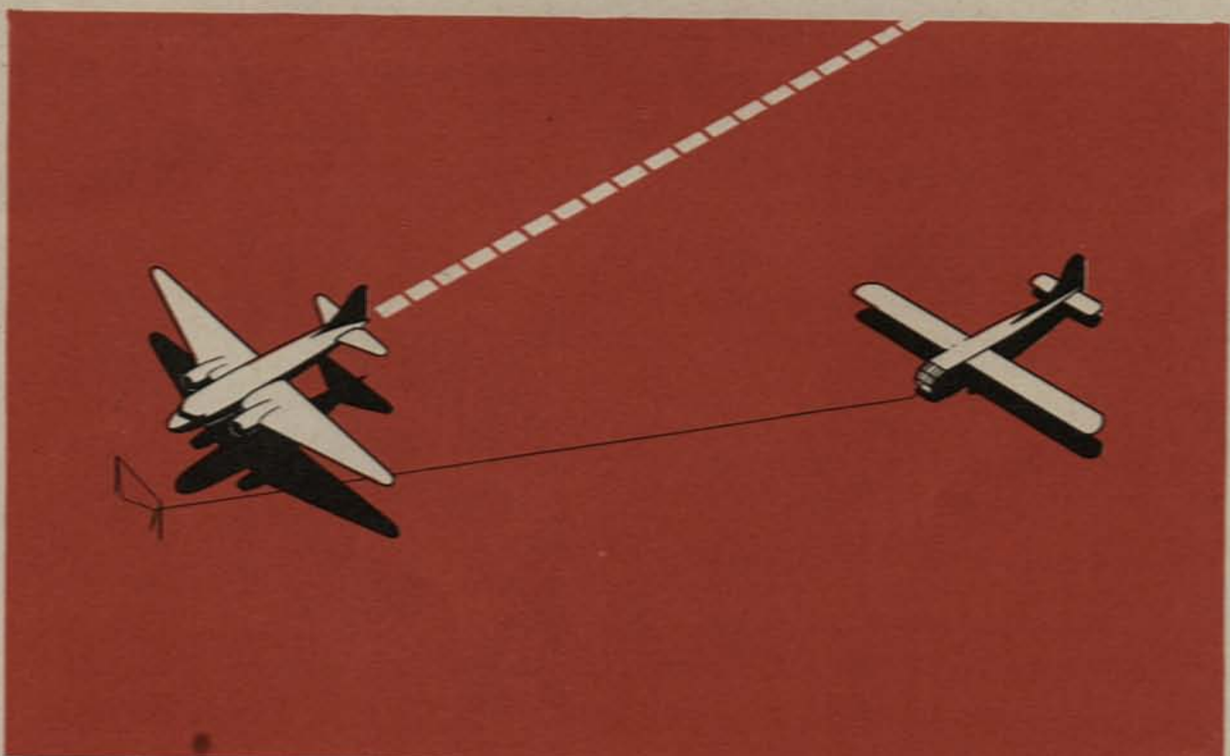
Development of a special pick-up unit permits a towplane, while in flight, to snatch a fully loaded glider off the ground with little more shock than the sudden jerk of a starting trolley car.

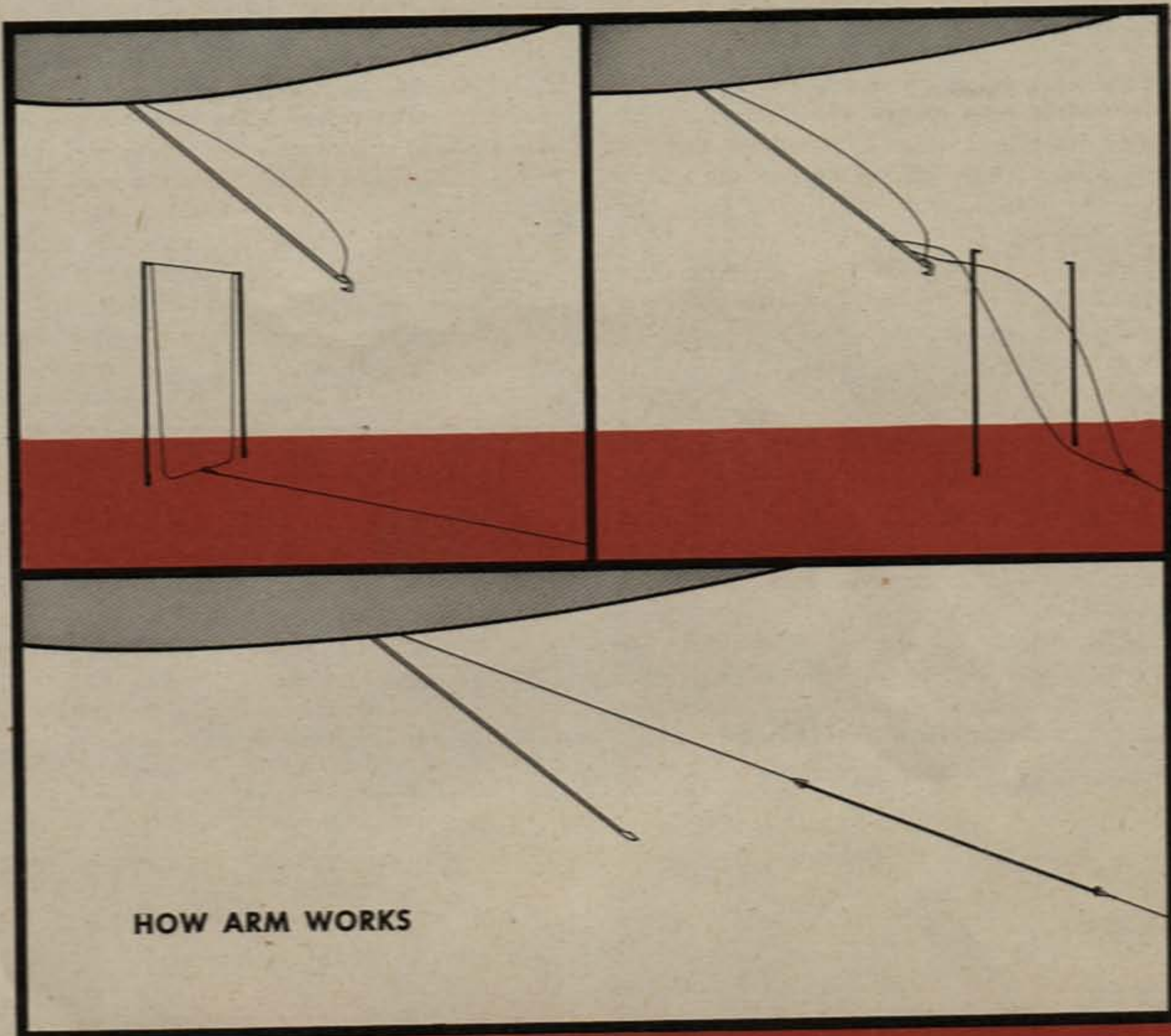
Pick-up offers one major advantage over normal takeoff: Gliders may be retrieved from small, rough, or muddy fields not suitable for power planes.

Pick-up already has been used to a limited extent in theaters of operation, and its future development and use may prove invaluable. It not only puts back into action a glider which otherwise might be lost, but offers a return trip for pilots needed for another assignment. The evacuation of wounded on a large scale also is a future possibility.

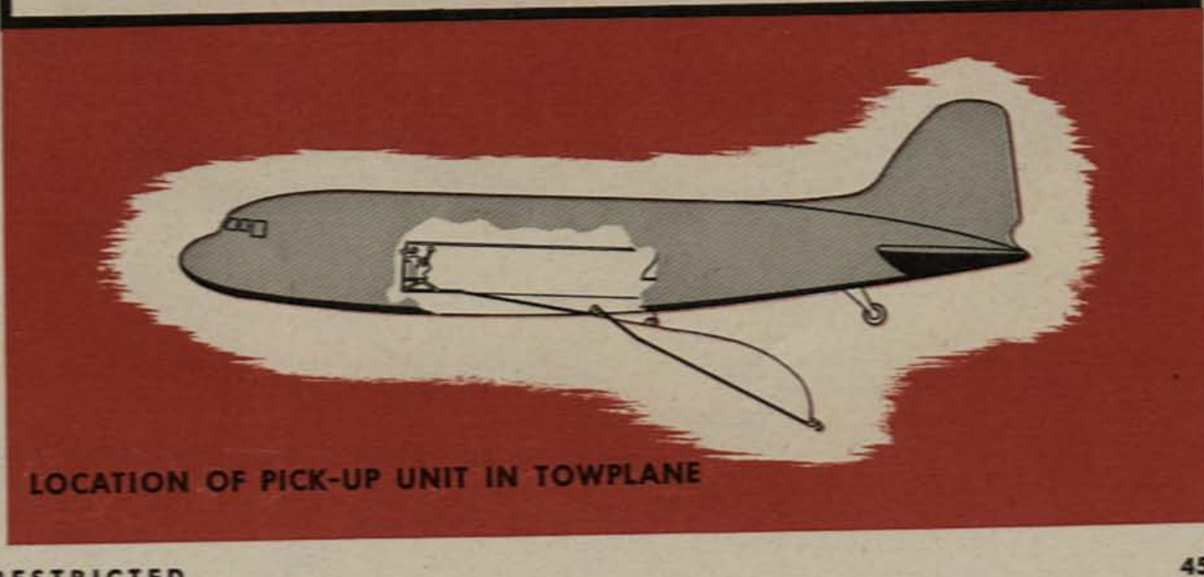
Oddly enough, the average acceleration for pick-up is only 7/10 of one G, which lasts but 6½ seconds. This is significant if you realize that pilots catapulted from shipboard in aircraft experience 2½G's. The unit which makes this possible is known as the Model 80. It consists principally of a drum which accommodates 1057 feet of cable, and a multiple-disc brake which is controlled by an automatic timing device. When the towplane contacts the glider in pick-up, the cable is paid out first rapidly, then more slowly as the brake takes effect. This steadily increased braking of the cable permits gradual, rather than sudden, acceleration of the glider until its speed equals that of the towplane. The cable pay-out is usually about 600 feet.

The speed at which the towplane contacts the glider averages between 130 and 145 mph, depending upon the gross weight of the glider and the condition of the terrain. The towplane loses speed as the glider is accelerated. The desirable resultant speed for C-47 towplane and glider is 105 mph. The maximum designed load of the pick-up unit is 8000 pounds.



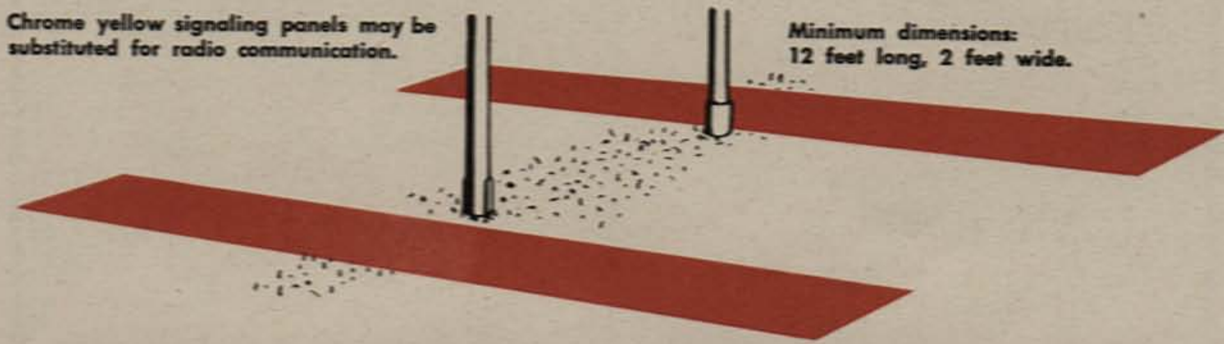


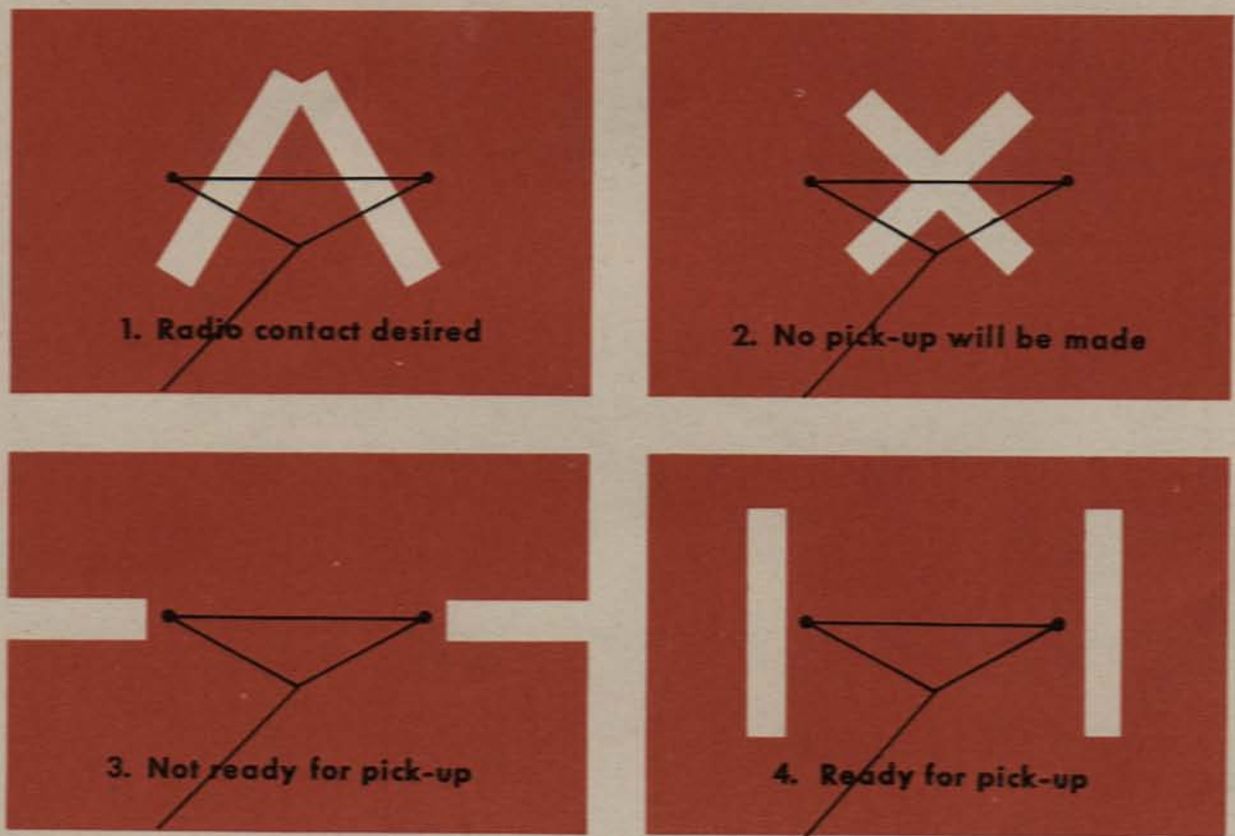
HOW ARM WORKS



LOCATION OF PICK-UP UNIT IN TOWPLANE

SIGNALS





BEFORE TAKEOFF

1. Inspect area 500 feet ahead of glider.
2. Make complete preflight check.
3. Set signaling panels to read "Ready for pick-up."
4. Establish radio contact with pick-up airplane if possible.

Transmit the following information:

a. Number prior pick-ups on this towline.
b. Approximate gross weight of glider.
c. Whether glider is on wheels or skids.
d. Type of terrain (sand, clay, etc.).
e. Inform towpilot when ready for takeoff.

GLIDER CARE

Control Locks—Perform a special preflight inspection on any glider you plan to fly if it has been standing without surface control locks and is unattended by a ground crew.

Check for possible damage to control surfaces, hinges, hinge brackets, control horns, and attachment of surfaces to torque tubes.

Be sure that surface control locks are installed after each flight you make.

Ground Towing—When tailwheel tow dolly is used, check to see that tailwheel safety pin is in place and locked. Otherwise the tailwheel may bounce out of the dolly and cause damage. Don't permit high-speed towing, or sudden stops.

When maneuvering near hangars, aircraft, or other obstacles assign a man to each wingtip.

Lifting Tail—Don't allow crewmen to put their backs or shoulders under the stabilizer to lift the tail. Tails damage easily because of their light construction. Lifting points are clearly indicated on the fuselage.

Plexiglas — Cover greenhouse with canvas covers when exposed to the sun. Extreme heat softens the glass, causing it to bend. This causes distortion in vision.

Clean Plexiglas frequently with pure water, using a clean, soft cloth. Use kerosene to remove grease and oil, but don't resort to strong soaps or solvents, because they cloud the glass.

MOORING

Wind is a constant threat to the grounded CG-4A because of its light wingload. For this reason, a knowledge of the proper method of mooring the glider is essential.

Use ¾-inch hemp rope, and attach as illustrated. Leave just enough slack in rope to allow for shrinkage and to prevent possible structural damage.

Secure control locks during all ground handling, and while moored.

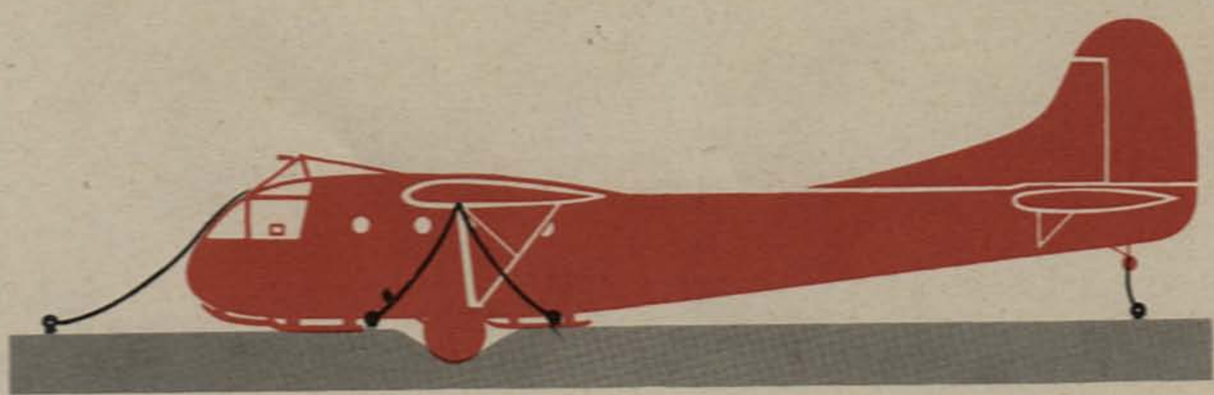
Use mooring spoilers when possible. Apply trailing edge protectors to prevent damage.

Glider on skids, wheels in holes, puts wing in no-lift position.

Keep the glider headed into wind, with its weight on skids.

Emergency Mooring

When an unexpected windstorm occurs during operation, head glider into wind, set parking brakes, tie spoilers in open position, install control locks. If any vehicle is available, park it in front of the glider, set its brakes and attach glider release mooring rope to it.



LOADING

Guesswork flying is as outmoded as the horse and buggy. The pilot who flies by hunches today may not live to fly tomorrow. He must understand the limits of his aircraft, and allow for a margin of safety.

This is particularly true in loading the cargo glider. Improper loading of the CG-4A reduces maneuverability, upon which you rely to get you down safely.

Glider loading involves four important factors:

1. Limiting the gross weight to that for which the glider is designed.

2. Placing the load so that the center of gravity (CG) is within the designed stability limits of the glider.

3. Distributing the load to avoid excess weight concentration on the floor structure.

TACTICAL LOADS THE CG-4A CAN CARRY

13 airborne troops

37 mm. AT gun

¼ ton truck (jeep)

Photographic laboratory

Weather station

Radar equipment

Field kitchen

75 mm. howitzer

Radio equipment

Repair shop

Six litters for evacuation of wounded

4. Securing the cargo to prevent it from shifting in flight or on landing.

The first—limiting the gross weight—is simply a matter of subtracting the basic weight of the glider from the designed maximum gross weight. The result is the allowable weight of men and equipment which the glider can carry.

Too great a gross weight causes:

1. Higher stalling speeds.
2. Lower structural safety margins.

THEORY OF WEIGHT AND BALANCE

The second—determining the proper position of the load—is a more complex problem. To understand the calculations involved you need some knowledge of the theory behind them.

The glider is held in the air by the lift which the wing creates. This lift is not evenly distributed over the width (chord) of the airfoil, but is concentrated in an area near its deepest portion.

The area about which the lift is concentrated is called the center of pressure (CP), because the difference in pressure of the air immediately above and below the wing is greatest at that point.

Because the force holding the glider up acts at the CP, the weight (or CG) must be focused immediately below that point.

If the CG is forward of the CP it causes:

1. Increased drag on the towplane, because you have to move the elevator from neutral to hold the nose up.
2. Difficulty in maintaining a tactical glide, because, under extreme conditions, the elevators reach the limit of their travel and are unable to hold the nose up enough to slow the glider down.

If the CG is too far aft of the CP, it causes:

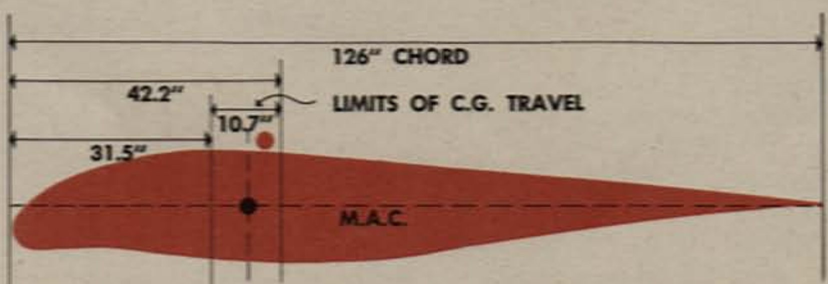
1. Dangerous stall characteristics (the nose is slow to drop, making recovery from a stall difficult).
2. Increased drag on the towplane, because you have to move the elevator from neutral to hold the nose down.

Limits of Travel for CG

A. T. S. C. engineers have determined, by actual flight test, the safe fore and aft limits for the CG. They define these limits in terms of a percentage of the chord of the wing. Actual figures for the CG-4A are 25% to 33.5% of the mean aerodynamic chord (MAC).

The MAC is a more specific kind of chord, designed for tapered wings. Since the wing of the CG-4A is rectangular, this MAC simply is the chord of the wing.

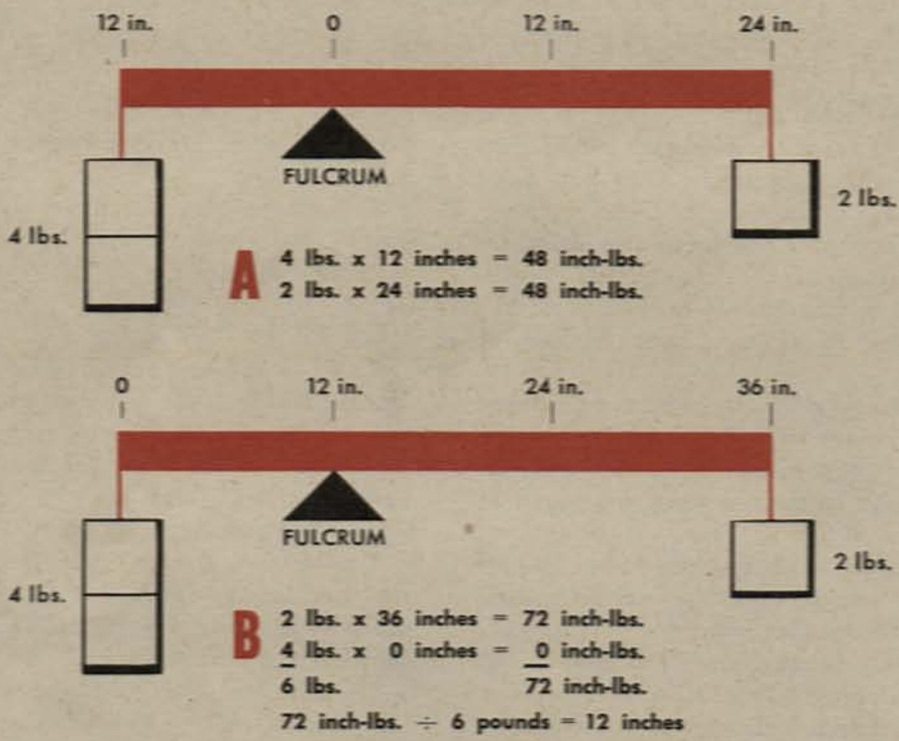
The MAC of the CG-4A wing measures 10 feet 6 inches. The CG limits are a percentage of this length, measured aft from the leading edge of the wing. Working this formula out, you find that the CG may range from 31.5 to 42.2 inches from the leading edge. The need for careful loading is apparent when you realize that this range allows only a 10.7-inch variation in position of the CG for safe flying.



25 to 33.5% of M.A.C. = Limits of travel of C.G.

• Center of pressure • 31% of M.A.C.—Recommended C.G.

FINDING THE CENTER OF GRAVITY



Finding the CG

Finding the CG is a simple problem in multiplication and division.

Note that a weight of 4 lbs. at a certain distance from the balance point is held in balance by 2 lbs. placed twice as far from the fulcrum. The balance point is the CG of the scale.

To solve the problem in balance, simply measure everything from one end of the scale arm, instead of from the middle. The problem is then pictured as shown in diagram B.

A 4-lb. weight is suspended at the zero end of the scale arm. At the opposite end is a 2-lb. weight acting on a total arm of 36 inches. The 2-lb. weight on the 36-inch arm has a leverage, or moment, equal to 72 inch-lbs.

The 4-lbs. weight has a moment of 0 inch-lbs. Thus the total of moments acting on the scale is 72 inch-lbs. Divide this total moment by the total weight of 6 lbs. This gives you an average arm of 12 inches. Thus, the CG, or balance point, for the scale is 12 inches from the zero position (reference point).

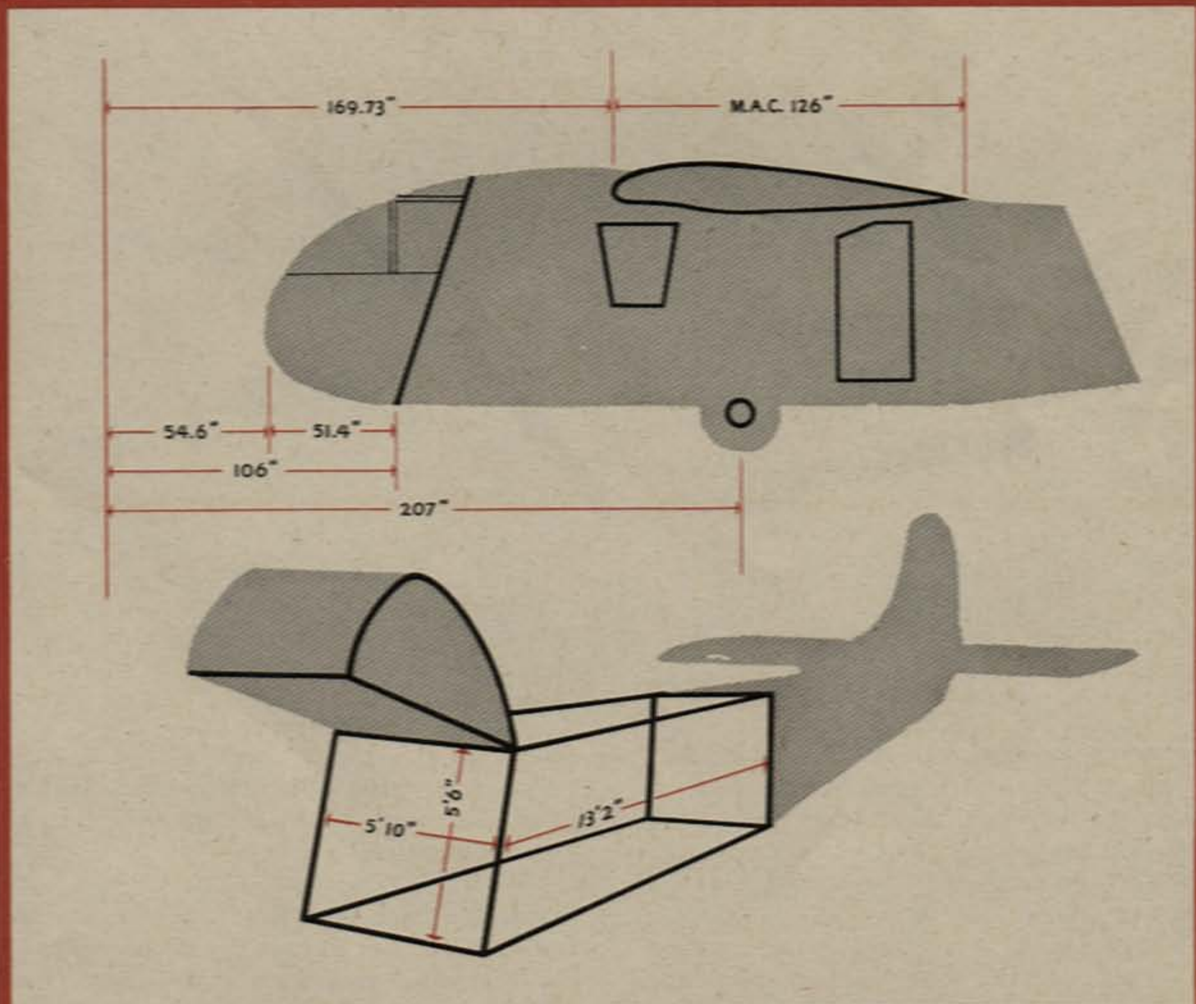
Finding the CG of a loaded glider is equally simple. The reference point from which the arms of various items of cargo are measured is 54.6 inches forward of the nose as indicated in the diagram on page 53.

To simplify load distribution, break the cargo down into easily handled lots or items. For example, cloverleafs of ammunition usually are stacked in groups of three. Consider the group one item. Measure the distance from the reference point to the center of the group, and you have the arm of the item. Figure the weight of the group of three cloverleafs, and use that as the item weight in calculating the moment.

The easiest way to measure the arm of an item is to remember that the distance from the reference point to the leading edge of the cargo floor is 106 inches. Make all measurements from this point, and add 106 inches, before making the computations.

Then multiply the arm (in inches) of each item, by its weight (in pounds) to get its moment. This done, add all the moments of the various items to the basic moment of the empty glider (found in the Weight and Balance book in each ship) to find the total moment for the loaded glider. This total moment divided by the gross weight gives you the average arm for the loaded aircraft, or the distance from the reference point to the CG.

To determine whether this CG is within the proper limits, add 169.73 inches (the distance between the leading edge of the wing and the reference point) to 31.5 (the distance between the forward CG limit and the leading edge of the wing) to get the distance between the forward CG limit and the reference point. The aft CG limit is checked in the same way.



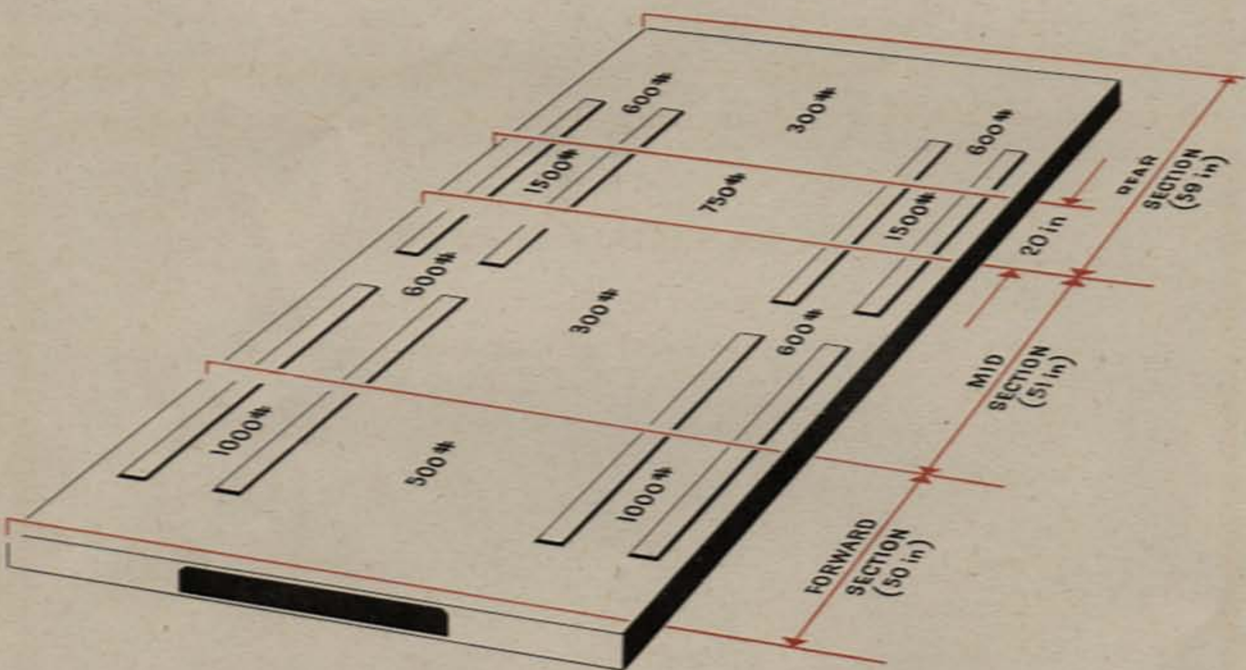
CARGO FLOOR STRENGTH

Distribution of the load to avoid excess weight concentration on any portion of the cargo floor is important in safe cargo handling. Heavy concentrations on the cargo floor may cause it to give way during a landing, damaging cargo and glider.

This chart shows the allowable weight concentrations by compartments. Notice that the sections between the guide-rails are strengthened to accommodate the concentrated loads of the ¼-ton truck and various other wheeled equipment.

To keep sharp load concentrations, such as tripod legs, from punching through the floor, place planking under them to distribute weight more evenly.

The maximum load concentration is 5 pounds per square inch.



SIMPLIFIED LOADING PLANS

In many cases you can load the glider safely by following one of two simplified plans.

Plan No. 1—When replacing men with cargo, allow 240 pounds per man, then center the weight of the cargo near the point where the man was seated.

Example: If six men of 240 lbs. each are replaced with 1440 lbs. of ammunition, the weight of the ammunition is centered at about the point where the two middle men of the six were seated. Adjust the cargo around this point to avoid exceeding the weight concentration allowed for that section.

Plan No. 2—This plan, based on the table shown on the following page may be used when the cargo you are to load doesn't exceed 3000 lbs. Otherwise, use the standard loading system described in the first part of this section.

SIMPLIFIED LOADING PLAN NO. 2

Weight of Cargo	Position In Cargo Compartment
Less than 1000 lbs.	Extreme forward position.
1000 lbs.	Centered 3 feet from front.
2000 lbs.	Centered 5 feet from front.
3000 lbs.	Centered 7 feet from front.

FACTS ON CERTAIN LOAD ITEMS

Item	Weight	CG Location
¼-ton truck	2366 lbs.	42 inches forward of rear axle.
37-mm. AT gun	975 lbs.	5 inches aft of axle.
Bicycle	60 lbs.	19½ inches forward of rear axle.
Handcart	80 lbs.	5 inches forward of axle.
75-mm. howitzer	1355 lbs.	7 inches aft of axle.
Solo motorcycle	575 lbs.	30 inches forward of rear axle.
¼-ton trailer	560 lbs.	5 inches forward of axle.
1-ton trailer	1350 lbs.	9½ inches forward of axle.

LOAD CHECK

A rough method of checking the CG position of the loaded glider is to see whether it balances on the landing gear. The gear is centered at Station 206.6, near the middle of the CG range.

To test this, have two men lift the tail of the glider after it is loaded. If the aircraft is tail-heavy, they will have difficulty in lifting it. If it is nose-heavy, the tail will have a tendency to fly up.

Reference for Additional Study

This manual is intended to serve as an aid and a guide to the pilot only newly acquainted with the CG-4A. For tactical information concerning the combat glider consult the manual "Tactics and Technique," distributed by the Troop Carrier Command.

The following is an outline of the basic Technical Orders, published and distributed by the Air Technical Service Command, which give detailed technical information about the CG-4A Glider.

T. O. Numbers	
01-1-10	Location of Technical Instructions in Gliders.
01-1-143	Towplane-Glider Combinations.
09-1-5	Mooring of Gliders.
09-1-9	Glider Towline Directional Angles.
09-1-12	Glider Tow Release Mechanism.
09-1-13	Glider Towline Assembly.
09-1-14	Glider Pick-up System.
09-40CA-1	Pilots Flight Operating Instructions.
09-40CA-2	Erection and Maintenance Instruction.
09-40CA-3	Structural Repair Instructions.
09-40CA-4	Parts Catalog.
09-40CA-5	Loading and Unloading of Airborne Task Equipment.

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